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SOUTH SEA CABLES.

Congratulations have been deservedly won by, and are heartily due to, the management of the Commercial Pacific Cable Company, on the completion of the first section of their system, reaching Honolulu. Next comes Manila in July, and soon thereafter China. We can only regret that Mr. Mackay is not alive to share with his son, Mr. George G. Ward, and other leaders in the enterprise, this successful fruition of part of their plans, which mean so much in the furtherance of American enterprise and commerce in the Far East. Whatever public memorial his family may hereafter elect to raise to his memory, Mr. Mackay has certainly created for himself a great monument in his Atlantic and Pacific cable systems, linked by land lines, and touching the Empire of Germany, in Europe, on the one hand, and the Celestial Kingdom on the other. Given the possession of great wealth, few men have been able to employ it so advantageously as did he for the benefit of the race and especially for the peaceful development of American enterprise. Such a great work could not be carried out except with the aid of loyal, enthusiastic and intelligent advisers, and to these we beg to tender our sincere and cordial felicitations. They have done wisely and well, and we trust that all their bold, well-conceived plans will soon be carried out to the letter. No South Sea "bubbles" are these, but golden links with the Asian shores, where lies so great a part of our national destiny.

THE WASHINGTON CONVENTION OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The convention last week, in Washington, of the A. A. A. S. was, on the basis of attendance, very successful. The numerical strength of the gathering was in the neighborhood of 1,400, and the communications presented aggregated more than 500. This necessitated the subdivision of the papers into definite groups; so that, at any one time, there were generally half a dozen different communications being presented to the various sections. Under such conditions the Baconian limitation of a body being capable of situation in only one place at any one time is severely felt. Under this condition there is a crying necessity for some system whereby publicity in print may be given to papers, but we regret to say that no provision whatever had been made to this end. Some hope of an improvement over past conditions in this respect was awakened by the conduct of the Pittsburg meeting, but the secretariat at Washington relapsed into its normal state of inefficiency, with the consequence that most of the papers presented might almost as well never have been rewritten. Until the American Association for the Advancement of Science organizes a permanent secretariat under a management similar to that of our professional societies, it will continue to remain a neglible factor in scientific advancement, and to occupy its present position of deplorable inferiority with respect to similar bodies abroad.

The presidential address by Professor Newcomb before the Astronomical and Astrophysical Society of America contained much matter of interest to the physicist. Among the topics discussed was the mystery of the apparent emanation of nebulous matter from the recently-born star, Nova Persei, that became visible to the inhabitants of our world between February 19 and 21, 1901, or less than two years ago. It was shown that the distance of this star from the earth was probably very great, probably many times as great as the nearest fixed star, with its four and a half years of light-speed interval. But the rate of development of nebular emission from Nova Persei during

the two years since its appearance has been quite appreciable in dimension as seen through telescopes. At the nearest possible distance of the Nova, this represents an enormous velocity of emanation or propagation. It had been suggested that the visible expansion of the Nova might be some function of luminosity, spreading out in all directions from the star with the velocity of light, or 186,000 miles per second (300,000 kilometers per second). This enormous velocity, however, was shown to be too small to account for the dimensions of the nebulous emanation at successive periods of its observed development. Moreover, the outline of the nebula was not sharply spherical, as the light-speed theory would entail. The emission extended somewhat raggedly in different directions. Consequently, it would seem that agencies are at work in the visible universe acting with velocities that may be many times greater than that of light.

In Physics, one of the most important papers was on the pressure of radiation, by Profs. E. F. Nichols and G. F. Hull. It has been known since the days of Maxwell that light should exert a pressure in the direction of its propagation, so that a beam of light may be said to try and push its way into the thing on which it falls. When we say that a ray of light *strikes* an object there is a certain amount of appositeness in the expression. The push of either luminous or non-luminous radiation is equal in baries to the volumetric radiation energy in ergs per cubic centimetre. A number of experimenters have searched for this radiation pressure. Crookes tried to measure the pressure exerted by a beam of light upon a vane suspended in an exhausted receiver. But the thermo-dynamic action of the residual gas in the chamber completely masked the effect sought. He tried to make a radiobarometer and discovered the radiometer instead. For years, the push of radiant energy has been obscured by the radiometer action of vacuum tubes, and the experimental determination has been rendered very difficult by the interference of residual gas-action on the suspended vane submitted to the radiant beam. Nevertheless, there has been a general belief that the effect existed, and its existence did not even depend upon the truth of the electromagnetic theory of light. That theory analyzed and accounted for the push; but any reasonable mechanical theory of wave propagation necessitates the admission of radiant push.

In the case of the experiments described before the section, a pair of spectacle vanes were suspended by a quartz fibre in a jar provided with windows in such a manner that the deflection of the vanes and twist of the fibre could be measured at any time, while a beam of arc light was allowed to fall on one vane. The deflection was measured both as a function of time and as a function of gas-pressure in the jar. It was found that the gas-action was at some pressures with the beam of light and at other pressures against it; so that at two particular pressures or degrees of vacuum the resultant gas-action was nil. By selecting the more convenient of these two pressures of no gas effect (16 mm. of mercury or about 1-50th atmosphere) and working at this exhaustion, the true radiant push could be observed. As a still further precaution, since the gas push increases with time, while the radiant push commences at full strength, the measurements were made ballistically, by allowing the beam to strike the vane for only six seconds at a time and measuring the resulting throw of the suspended system. In this ingenious way the observed radiant push was found to be within about one per cent. of the calculated push. The magnitude of the push is, of course, quite small, being only a few microbaries in fairly strong arc light. One of the applications of this principle of radiant push was exhibited experimentally by the authors of the paper in the form of a miniature comet's tail. It has been shown at various times in the past that since the surface area of a mass of matter increases as the matter becomes more finely divided, there must be a certain limiting size of material particles at which the radiant push of the sun on their surface is greater than the gravitational pull on their mass. Below this size, material particles would move away from, or be seemingly repelled by, the sun. Consequently, since comets carry their tails behind their backs when advancing toward the sun, and before their faces when receding from him, it has been supposed that this repulsion of the sun for the tails was due to radiant push on the extremely tenuous caudal matter.

A sort of hour-glass vacuum tube was exhibited which contained some carbon sponge dust of particles only one or two microns in diameter, the chambers having been very carefully exhausted to as a high a vacuum as possible. When the dust was allowed to fall from the upper to the lower chamber in a powerful arc-light beam, the larger particles were seen to fall vertically; while the finer ones fell out of plumb, and away from the light. The angle of deviation was stated to be about that to be expected on the radiant push hypothesis.

THE WIRELESS TELEGRAPH SITUATION.

The recent work of Marconi has raised his transatlantic experiments to the dignity of a serious demonstration. That their character has been conclusive to a degree not shared by the experiments of a year ago is to be attributed to material improvements in the receiving apparatus and more especially to the more adequate energy utilized in the transmission. The cruise of the *Carlo Alberto* last summer gave full warrant for the reasonable expectation of readable messages across the Atlantic whenever the work was attempted with adequate sending and receiving apparatus. In a few days another attempt to increase the working radius of action will be made from the Marconi station at Wellfleet, Mass., with every expectation of success. Transatlantic wireless telegraphy must now be regarded as an accomplished fact, and must be reckoned with seriously as such. Its possibilities and limitations have yet to be discovered. We earnestly hope in this connection that the inquisitive Mr. Maskelyne, who industriously kept tab on the cruise of the *Carlo Alberto,* has not deserted his post. His record, although disputed with some acerbity, did go far toward convincing doubting minds of the tremendous possibilities of the art. It was distinctly more satisfactory than any report coming wholly from interested parties could be and it furnished, moreover, information regarding the difficulties to be surmounted which the Marconi Company could not reasonably be expected to be made public. It furnished, too, a datum line from which to measure present and future improvements, a thing of itself most useful and desirable.

For instance, it now appears that the speed of transmission of messages is reasonably high, and can doubtless be pushed higher. It was not to be expected that in the experimental sending to the *Carlo Alberto* speed would be pushed to the limit or anywhere near it. The point to be demonstrated was distance, and for the time being speed was a non-essential. A profoundly interesting part of the record then obtained was the apparent advantage of sending at night, but whatever may have been the cause of this, the difficulty seems now to have been in great measure overcome, since the recent work is reported to have been done in full daylight. On the other hand, this raises the question whether the previous difficulty in daylight sending may not have to be charged to the secondary, perhaps meteorological, conditions rather than to the intrinsic effect of sunlight suggested by Marconi. There are numberless questions of this kind that must arise in practical working and which can only be settled by considerable experience. The relation of wireless telegraphy to the world's cable systems seems to be an indeterminate quantity as yet, but as Marconi has pointed out, the wireless plant has so immense an advantage in the matter of fixed charges that it will constitute itself a very wholesome

competitor, even if it should prove to be more erratic in its working. And competition, modern American practice to the contrary notwithstanding, is a good thing. But really it seems to us that transatlantic wireless telegraphy is less important than the easier and less sensational task of keeping in constant touch with vessels even a few hundred miles from the coast. This is now in theory a commonplace affair, but it is far from being worked to its full value. We should much like a record, not of the messages thus sent, but of those which have failed to get through. It seems more than likely that in this case lack of power is at the bottom of the difficulty, just as it has been with the attempts at using portable wireless telegraph sets for military purposes. This important use of the system seems to have made singularly little headway, and so far as we have learned, has, save experimentally, scored a long series of abject failures.

In any event the big work now fairly under way raises more strenuously than ever the question of possible interference, its remedies and regulation. Syntonic working seems as yet to have made little appreciable progress; and what is going to happen if, for instance, Mr. Tesla cuts loose with his big plant on Long Island in a determined attempt to open communication with Manila? There is certainly no reasonable excuse for interfering with his right as a good American citizen to use the air, about the only common property left us, for experiments of obvious and practical importance. Yet if he chanced to open fire on the ether at the time when Marconi was launching expressions of cordial regard at the distinguished Ahkund of Swat, trouble would very probably ensue. The question is not at all to be taken lightly, for it deals with very probable conditions. It seems to us that the Kaiser's call for international discussion and regulation of the whole question was most pertinent. Unless something of the kind is undertaken there is certain to be vexatious interference and venomous litigation, and we can imagine no cause more likely to require two or three generations for its settlement than an action arising from an etheric collision with a full line of expert testimony on each side. The French Spoilation Claims would be a police court case compared with it. If, as now seems likely, the world is to be dotted with wireless stations employing divers systems and all working in a common medium, there must be something more direct and effective than ordinary legal methods applied to its regulation, and a full international discussion would go far toward clearing the air—not to say the ether. One thing at all events is assured, that Marconi has scored a most notable success even now, and what he may do later is hardly to be predicted. He is certainly doing honor to the noble heritage which has come down to him from a long list of illustrious Italian men of science, and his country and the world may well be proud of his achievements.

SOME LIMITATIONS OF WATER POWER.

The tremendous growth of power transmission in the last few years has compelled public admiration, and, in addition, has tended to blind the public to some of the difficulties in the water power situation. Most of the power transmission thus far undertaken has been commercially successful, but this has been due rather to the inability of hazardous schemes to get upon their feet, than to the inherent cheapness of water power. A half century ago, when fuel was costly on account of lack of transportation and engines required double the amount of steam required in present practice, the development of water power saw its palmiest days. Investments were made on propositions that to-day could not raise $15 on the street, and some that promised well stand to-day burdened by a weight of fixed charges that would stagger any new enterprise. It is a fact well known to practical engineers that many, perhaps most, of the older water-power developments of New England actually represent an investment that if honestly charged against them would not permit them to sell power in competition with a steam plant. There may be behind them a record of profit and loss accounts and reorganizations that enable the present owners to show a profit, but the whole proposition is intrinsically uncommercial. On the other hand, the claims made by steam engineers, especially those based on mill practice, must be received with great caution as a basis of comparison. Absurd claims are often made in behalf of both steam and water, and a brief analysis of the present situation may be not without value.

To begin with, water power presents the unusual feature of nearly fixed cost irrespective of output, so far, at least, as the generation of electricity goes. It seldom pays to develop a stream partially, and when the property is secured and the hydraulic development made, the cost of running is about the same for all loads extending over the same number of hours per day. Hence water power is cheap, other things being equal, when it can be fully utilized all the time, and dear when the load factor is poor. If a water power is bought, or water is rented on the basis usual in the hide-bound old plants built for running mills, the price is simply ruinous, so far as electric generation is concerned. And unless the power is, humanly speaking, absolutely continuous, its value for electrical purposes is greatly reduced, since the plant then has to carry the burden of a complete steam reserve. We could mention a number of electrical plants using water power in which the cost per horse power is demonstrably higher than it would be with a good modern steam plant—not one of the mill plants estimated on paper or operated wholly in the bookkeeping department—but such plants as one actually finds in electrical service. More than this, we have seen plants go to an expense for storage and auxiliary plants to enable a water power to be fully utilized that ensured a net yearly loss over a straight steam plant. And this is the case with coal at normal prices for points not near the mines, so that a portion of it would be doubly true for districts where cheap coal or cheap fuel oil can be obtained. The moral is that in going ahead with a water power proposition one should exercise the greatest caution in making sure of the exact conditions of flow and the economies of the fuel situation present and future.

The reverse of the bill is the great uncertainty as to the real cost of steam power, not the cost figured in the designing engineer's notebook or from the ledger in the first year of operation, but from the grim total that piles up as the average of a decade. We constantly hear of plants in which the cost per kilowatt-hour is almost any small fraction of a cent, but we know well the items that have been dropped out of sight, and it is dollars to pennies that within twenty years the whole plant will be reorganized and the cost charged up to improvements and covered by an increase in capitalization. A sinking fund is almost an unknown quantity in the finances of electric plants, and while it is true that a sinking fund cannot easily be applied to the meeting of material obligations that mature, not at any fixed time, but as the art changes, the case demands for that reason a far larger allowance for the changes that inevitably come. Moreover, it looks at present as if in the future cheap fuel was to be classed as an "iridescent dream." With the coal supply demonstrably in the hands of a virtual, if not a formal, trust, and the fuel oil, save in a few isolated producing districts, absolutely in the hands of a close monopoly that does not scruple to keep its prices on the heels of coal, it will be far safer to look forward to $5 steam coal than to exhaustless culm piles to be had for the asking. This is the menace that makes reckoning on steam power a trifle uncertain. Every rise in the price of fuel gives water power an advantage, and a good fall well utilized cannot be brought to the verge of ruin at the will of a group of coal barons on strikers. Many a small electric plant is hard pushed this winter, and more than one will go to the wall, but the chap who is running on water can afford to sit by and grin. Intrinsically, water power has some serious elements of uncertainty, but once acquired it is a permanent asset through cheap coal and dear

American Appointment for Prof. J. J. Thomson.

Every American interested in physical science will be interested to learn that another great English scientist has decided to accept an invitation from the United States. Prof. Joseph John Thomson, D. Sc., F. R. S., 1889, for the last eighteen years Cavendish Professor of Experimental Physics at Cambridge University, England, was appointed this week by the Trustees of Columbia University head of the Department of Physics, to succeed the late Ogden Nicholas Rood.

Prof. Thomson was born at Manchester in 1856, and attended Owens College and Trinity College, Cambridge. At Cambridge he was Second Wrangler and Second Smith's Prizeman in 1880, Fellow of Trinity College in 1881, lecturer in 1883, and President of the Cambridge Philosophical Society in 1894. In 1896 he was elected President of Section A of the British Association and is a member of the Athenæum and Saville clubs. His recent work in the investigation of atoms and molecules, and their relation to electrical charges, is fresh in the mind of the public. Prof. Thomson not long ago accepted an invitation to give a series of lectures at Yale, as noted in these pages.

The Trustees voted to designate the physical laboratories for research work by the name of the Phoenix Physical Laboratories, in memory of Stephen Whitney Phoenix, of the class of '59, who left a large sum to the University several years ago for physical research.

December Meeting of the A. I. E. E. in Chicago.

The Chicago members of the American Institute of Electrical Engineers met in Chicago on Tuesday evening, December 30, to discuss the subject of "Braking and Traction Brakes." The paper by R. A. Parke on "Railroad Car Braking," was read by T. P. Gaylord in abstract. The paper by J. D. Keiley on "Some Brake Tests and Deductions Therefrom," was read in abstract by B. J. Arnold. Mr. Gaylord, at the close of his reading, called attention to the necessity for larger motor equipments for electric brakes, where the motors were used as generators, and said that complaints from electric brakes were likely to be due to having a too small motor equipment designed only to be used for accelerating and propelling the car.

B. J. Arnold, at the close of his reading, spoke of the tests which he made about a year ago on comparative steam and electric traction, in which a negative acceleration or braking at the rate of three miles per hour per second was obtained in a few instances.

J. R. Cravath called attention to the fact that it is only very recently that interurban roads have felt the necessity of increasing the rate of braking common in ordinary service stops. Recently he had known at least one high-speed interurban road upon which the regular schedules would be so fast as to call for a rate of braking almost equal to an emergency stop. The question had come up how to accomplish, with an ordinary straight air brake, what a Westinghouse automatic high-speed brake does in applying the brakes with high brake-shoe pressure at first and gradually reducing this pressure to compensate for the increase in brake-shoe friction at the lower speeds. In one case he believed it was proposed to accomplish this by teaching the motormen to apply the brakes with high pressure at first and gradually decrease this pressure as the car lowered its speed. This would call for considerable skill on the part of the motorman, but much judgment is required by him anyway, with a modern interurban straight air brake apparatus, because the storage reservoir pressure is usually much greater than could be let into the brake cylinder without sliding the wheels. Care is thereofore required in every application of the brakes.

An informal discussion followed, which was taken part in by a number of members, on the recently exploited apparatus for increasing the coefficient of friction between the wheels and rails by means of magnetism, thereby increasing the possible rate of braking on a slippery track.

E. B. Clarke described briefly the braking precautions on an ore-carrying machine in the Illinois Steel Company's plant, of which he is electrical engineer. This machine had air, electric and hand brakes. There had been some trouble with broken axles that he had suspected was due to the use of the electric brake and inquired whether trouble from this source had been experienced in railway work. None of the members seemed to have heard of any unusual trouble of this kind on roads employing the electric brake.

The question of the rapidity of action of the Westinghouse quick-acting automatic air brakes on long trains came up. R. H. Pierce spoke of some apparatus which he knew of a number of years ago, for applying the air brakes under all the cars of the train simultaneously, by means of electricity. B. J. Arnold told of tests which he witnessed in 1887 on the quick-acting automatic air brake on long trains, and showed that the application of the brakes on the rear cars of a long train was more nearly simultaneous with the movement of the engineer's valve than if the rate of brake application had been transmitted through the train with the velocity of sound. While electrical apparatus for working the valves under each car was instantaneous, it was evidently not enough better than air to justify the complications it would involve.

Commercial Pacific Cable at Honolulu.

After a gallant fight with wind and wave, the cable steamer *Silvertown* succeeded in landing the shore end of the Commercial Pacific Cable at Honolulu as the old year ended and the new year began, and connection through to San Francisco was made, January 1, at 8.43 p. m., Honolulu time. The next step, that of connecting Manila, is already being taken. A great many messages of celebration were exchanged, notably the following:

Honolulu, January 1, 1903.

The President, Washington:

The people of the Territory of Hawaii send their greetings to you and express their gratification at the inauguration of telegraph communication with the mainland. We all believe that the removal of the disadvantage of isolation will prove a strong factor in the upbuilding of a patriotic and progressive American Commonwealth in these islands. (Signed) Henry E. Cooper,
Secretary of Hawaii.

The President's response was as follows:

White House, Washington, January 2, 1903.

Henry E. Cooper, Secretary of Hawaii, Honolulu, Hawaii:

The President sends through you to Gov. Dole and the people of Hawaii his hearty congratulations upon the opening of the cable. He believes that it will tend to knit the people of Hawaii more closely than ever to their fellow-citizens of the mainland and will be for the great advantage of all our people. (Signed)
George Cortelyou, Secretary to the President.

Honolulu, January 1, 1903.

Mr. Clarence H. Mackay, President, New York.

We send this token of our high appreciation of the completion of the great enterprise undertaken by your company of laying a telegraphic cable from the coast of California to these islands. Mingled with our joy there is a feeling of deep regret that John W. Mackay did not live to see the completion of his project, and we assure you that his name will ever be cherished in fond remembrance by our people. (Signed) Henry E. Cooper,
Secretary of Hawaii.

Honolulu, January 1, 1903.

Geo. G. Ward, Vice-President and General Manager, New York.

To your untiring efforts Hawaii is indebted for an early consummation of the enterprise that means untold advantages to all her interests, and we tender our hearty New Year greetings and trust that the final completion of the entire project will be to your full satisfaction. Henry E. Cooper,
Secretary of Hawaii.

Messrs. Clarence Mackay, President George G. Ward, Vice-President and General Manager, and the other officials of the Commercial Pacific Cable Company are naturally greatly pleased at the completion of the company's cable between San Francisco and Hawaii. They state that by July 4 they expect the cable will have been completed to Manila. Mr. Ward said: "The Commercial Pacific Cable Company's cable to Hawaii was connected through to San Francisco at 8.43 p. m., January 1 (Honolulu time). The cable opens for public business on Monday morning, January 5. The widespread interest and enthusiasm created by bringing the Hawaiian Islands into electric touch with the Pacific Coast is evidenced by congratulatory cablegrams received to-day. It is a particular satisfaction to us to have the cable completed on the first day of the new year, because it fulfils our promise to Congress. Rapid progress is being made in the manufacture of the sections to be laid between Honolulu and Manila, and over 3,500 miles of this cable have already been manufactured, and I fully expect messages will be exchanged with Manila by July 4 next. The laying of the remaining sections will commence from Manila the first week in May next."

Electrical Supply From Water Power at Portland, Me.

BY ALTON D. ADAMS.

SEBAGO LAKE, 270 feet above mean low tide, 50 square miles in area and with a drainage basin of 470 square miles, furnishes the energy for a great part of the electric light and power distributed in Portland, Me., seventeen miles away. The only outlet of this lake is the Presumpscot River, 21.6 miles in length, which empties into Casco Bay, about four miles north of Portland. This short stream, with its total fall of 270 feet, or 12.5 feet per mile on an average, offers a succession of water powers. At one of these powers known as Great Falls, in North Gorham, the generating station of the Portland Lighting & Power Company is located, distant thirteen miles from the sub-station in Portland. Sebago Lake forms an ideal storage reservoir because of its great area compared with that of its drainage basin. As the figures for these areas show, the lake has one square mile of surface for each nine square miles of the territory which it drains, so that a moderate rise in the lake level will provide storage for a large percentage of the water annually flowing into it. During more than a decade records have been kept of the total discharge of water from Sebago Lake, and the annual average has been found to represent a rainfall of 21 inches over its 470 square miles of drainage area. It follows that this entire annual run-off would raise the lake level only 15.75 feet if all of it were stored. As a matter of fact, the average annual variation during a period of more than ten years has been 5.75 feet between the extremes of lake levels. From records extending back to 1887 it appears that the average annual discharge of water from the lake has amounted to 800 cubic feet per second. These facts give to water powers on the Presumpscot River a degree of reliability and constancy second to no others in New England. The storage capacity of Sebago Lake is made available for all the water powers on the Presumpscot River by a stone dam at the head of the latter which raises the elevation of the lake surface during the wet seasons.

The water privilege of the Portland Lighting & Power Company on the Presumpscot includes the entire flow of the river over two falls about 3,000 feet apart. At Great Falls, the larger of the two, the river drops 37 feet, and at Whitney Falls, further down stream, the descent is 18 feet. At present only the upper and greater fall is fully developed and in use, but the application of the lower fall to electrical supply in Portland is probably a matter of the near future. Behind the dam at the fall now in use is a pond about one mile long, 1,000 feet wide and 15 feet deep, that serves to store or release water as required by the daily fluctuations of load. At the lower falls the Portland company has secured the river frontage on both sides for a distance of about one mile, so that a storage pond may be created there when the power is developed. At Great Falls, the location of the present generating station, the dam, 450 feet long, 22 feet high, and 24 feet wide at the bottom, is built on a solid ledge. This ledge thus provides 15 feet of the total 37 foot fall. For about 360 feet of its length the dam is of the crib type, filled with stone, and for the remaining 90 feet the construction is coursed masonry. This masonry portion of the dam acts as a forebay wall from which four steel penstocks pass to the generating station, the rear wall of which is 40 feet distant. East penstock is eight feet in diameter, constructed of ⅜-inch plate, and enters the forebay wall ten feet below the surface of the water in the pond. In this way water is drawn from the bottom of the pond, the surface is left quiet, so that it freezes over with the first cold weather, and all trouble with anchor ice is avoided. Though the equipment of this plant is just being completed, one generator has been in operation during two winters and has never been shut down a minute on account of anchor ice. The power station is built on solid ledge, one story, with brick walls, interior posts and crane beam of structural steel; cement floor, and plank roof covered with tar and gravel. On the ground the station measures 54 by 57 feet and 18 feet from floor to roof, with an extension in the rear 15 by 28 feet. Close to the rear of the station is a brick building 10 by 12 feet on the ground, with cement floor and corrugated iron roof, which is used in part for the lightning arresters connected with the transmission lines and in part as a wash room, also to store oil and waste. No fuel is burned in any part of this plant, all heating being done with electricity, even to the hot water in the wash room. Two cranes, one on each side of the station, sweep the entire area of the main room. The station is lighted entirely by incandescent lamps at the roof. Close to the station on two of its outer sides tail races have been cut through solid rock, and these tail races unite at a point between the station and the place where the water joins the river. Each of the two tail races receives the discharge from two pairs of water wheels.

FIG. 1.—GENERAL VIEW OF WATER POWER PLANT AT GREAT FALLS, ME.

The penstocks above mentioned are provided with overflow pipes

in order to avoid heavy strains when the flow of water through any wheel is shut off quickly. Each of the four penstocks already named is provided with a gate in the forebay wall and delivers water to a pair of Victor turbines. A heavy steel rack extends in front of all the gates. Each turbine case contains a pair of wheels, and is partly inside and partly outside the station wall, so that the draft tubes are entirely outside of the station. As two wheel cases enter the station from the rear and two from the sides, the line of two wheel shafts is at right angles to the lines of the other two. This plan was adopted to enable the operator to follow indications at the switchboard more promptly.

Each turbine wheel is 33 inches in diameter, of the central discharge type, and operates at 225 r. p. m. under the head of about 37 feet. Each pair of wheels is rated at 880 horse power and is direct connected to a 500-kw. generator, which latter can thus be overloaded about 24 per cent., if its efficiency is 94 per cent. The four 500-kw. generators are of the revolving magnet type, three-phase, 60-cycle, and operate at about 10,000 volts. Belted to each generator shaft is an exciter of sufficient capacity for two generators. All of the electrical machinery is the product of the General Electric Company. The speed of the connected water wheels and generators is regulated by four Lombard governors belted to the generator shaft in each case. The main cylinder of the governor is 6 by 24 inches, and the energy 11,300 foot-pounds, which may be developed in two seconds, if required.

At the rear end of the station a marble switchboard is fitted with oil switches and indicating instruments for each generator. Four transmission lines of three wires each are also to connect with this board, one to carry the current of each generator. The fourth pair of turbine wheels and fourth generator is being installed at this time, so that the photograph taken some time ago shows one vacant foundation, and only three lines entering the switchboard. The transmission lines pass from the switchboard to the rear wall of the station and through this wall to the transformer house previously named. Connections between the generators, exciters and

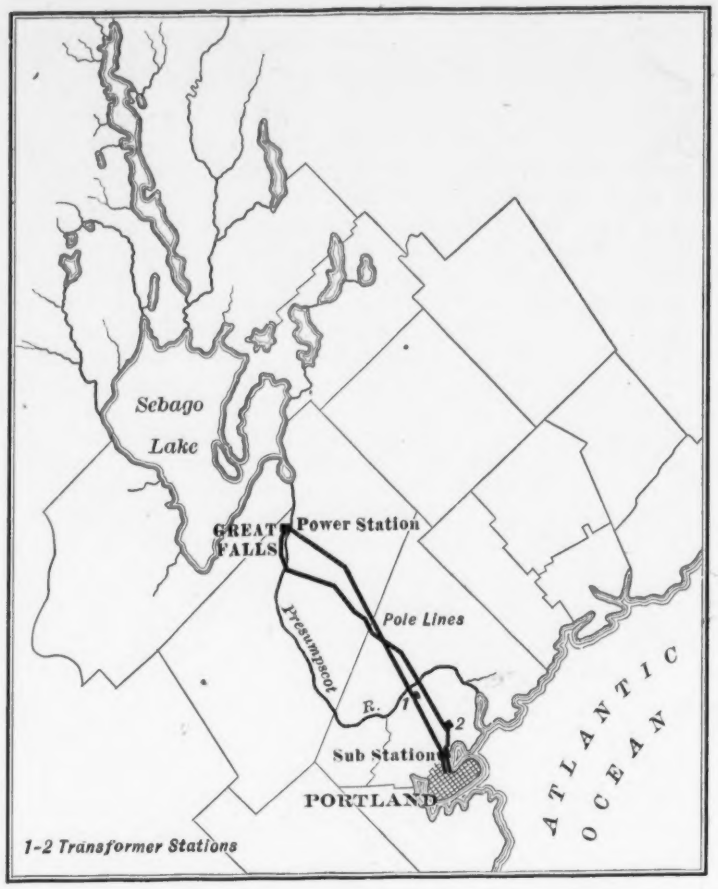


FIG. 3.—MAP OF ROUTE OF TRANSMISSION LINES.

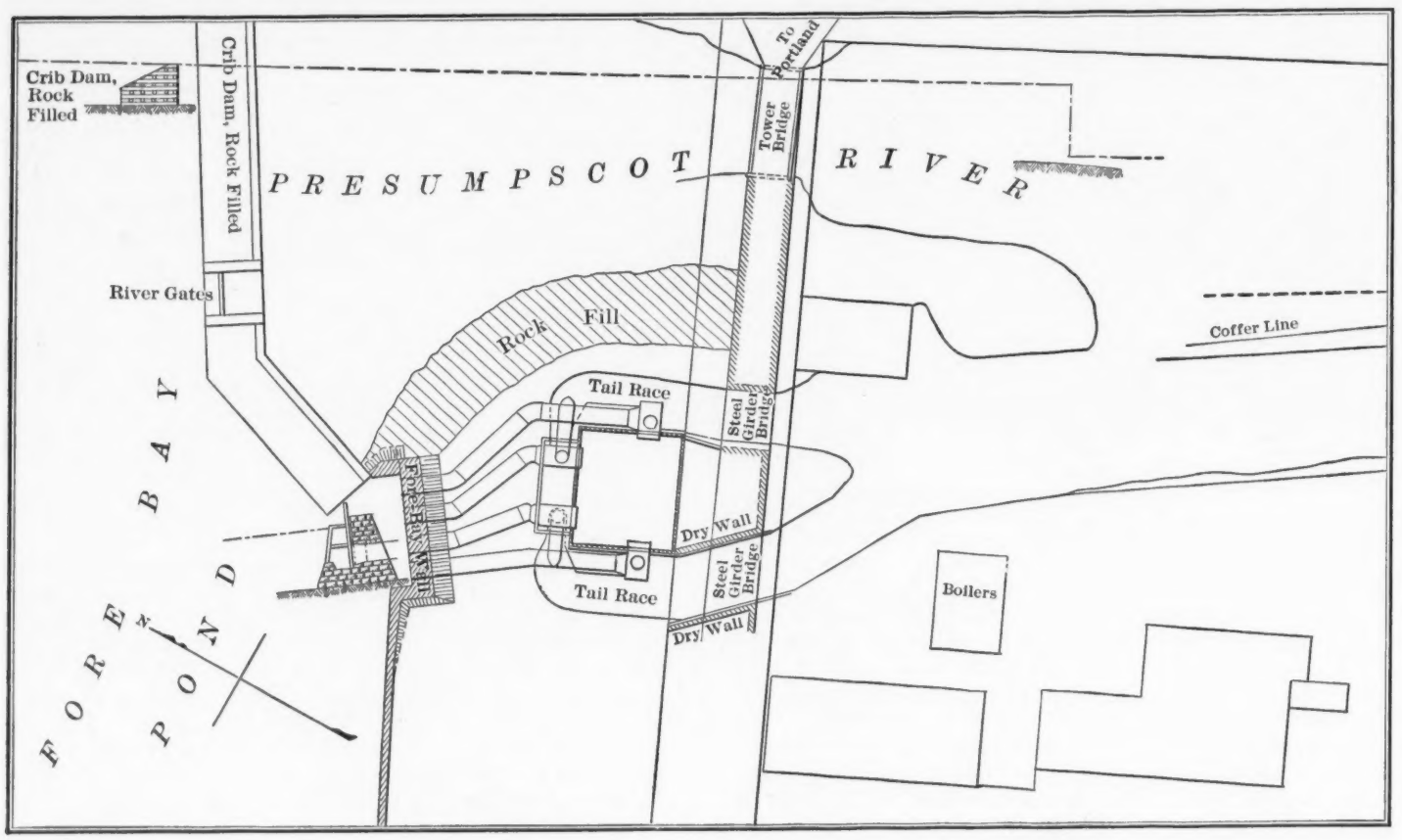


FIG. 2.—PLAN OF PLANT AND DETAILS OF DAM CONSTRUCTION.

switchboard are all affected by cables laid in conduits beneath the concrete floor of the station. A series of hand holes with iron covers, as shown in the photograph, gives ready access to all of these connecting cables. After connection to series of lightning arresters the transmission wires pass out over two lines of poles on their way to Portland. These two pole lines by different routes extend from the generating plant to the sub-station in Portland, a distance of 13 miles.

As may have been noted, this transmission system is divided into four entirely independent sets of apparatus, each extending from a gate in the forebay wall of the dam to the sub-station at Portland. These four sets of transmission apparatus are usually operated inde-

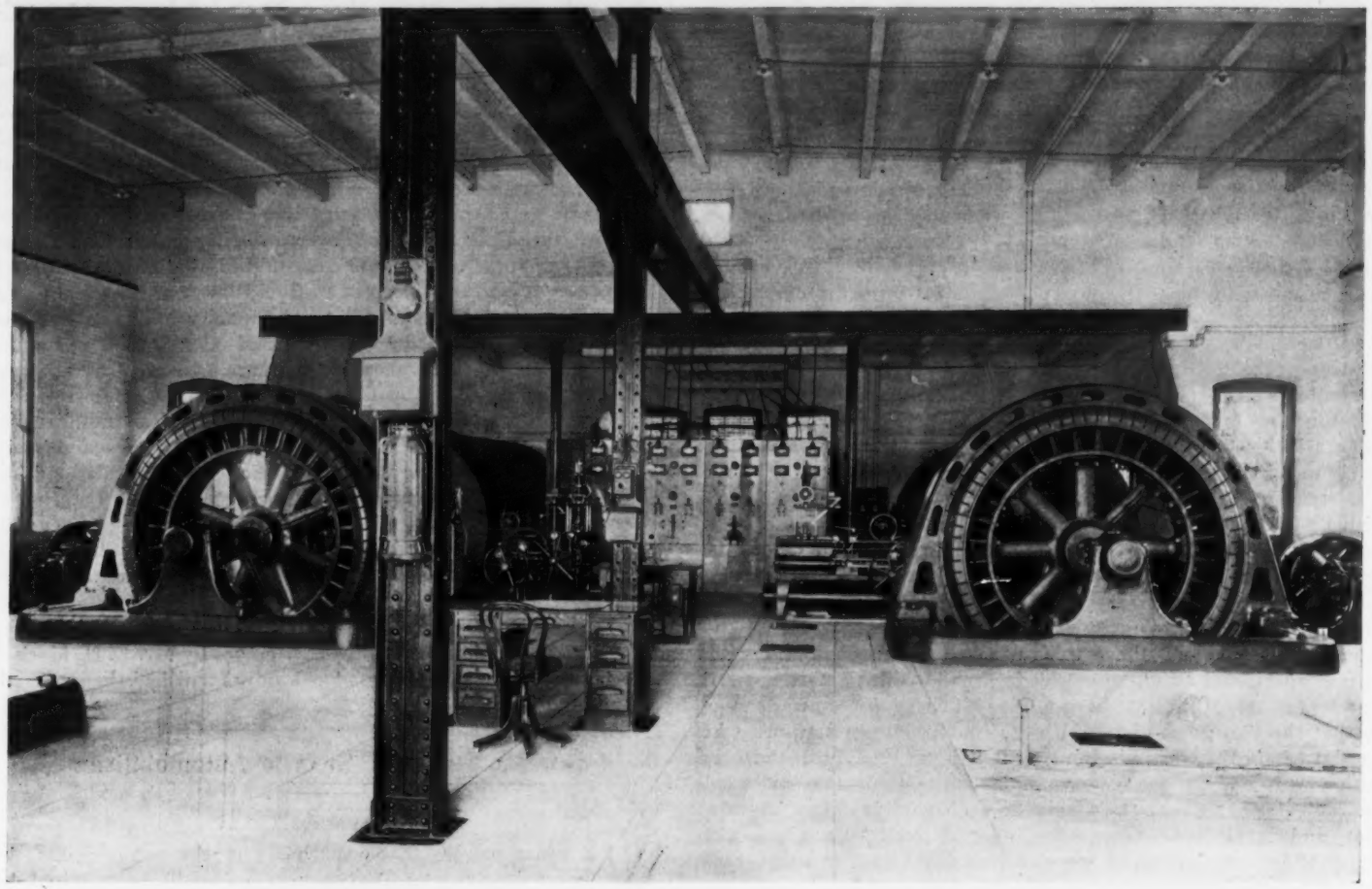


FIG. 4.—GENERAL VIEW OF INTERIOR OF POWER PLANT.

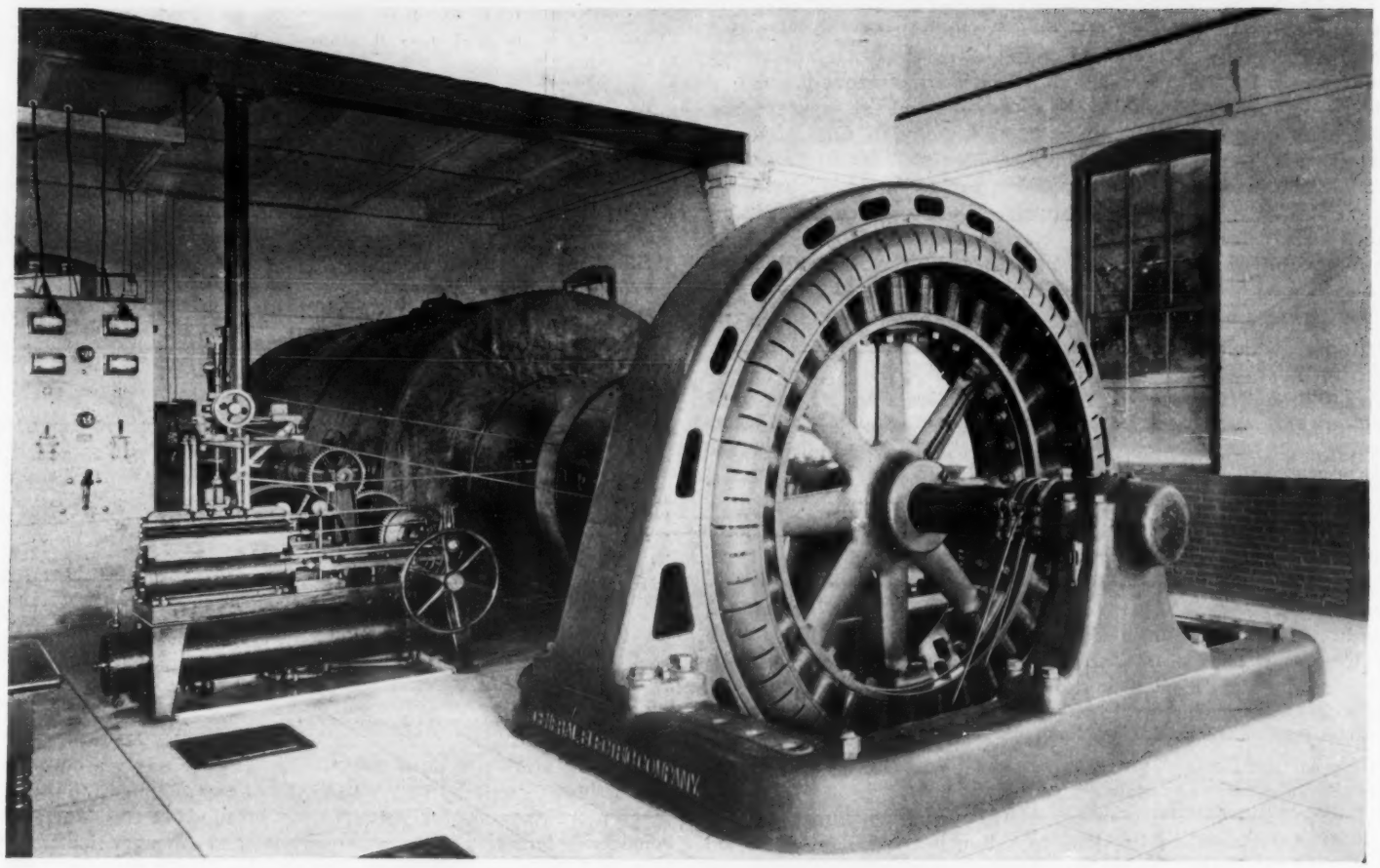


FIG. 5.—WATER WHEELS DIRECT-CONNECTED TO 500-KW., 60-CYCLE, 3-PHASE, 10,000-VOLT GENERATOR.

pendently of each other, one generator and circuit being devoted exclusively to motors, another generator and circuit to a certain part of the lighting load, and so on. The object of this arrangement is to avoid fluctuations due to changes in some parts of the load and particularly to avoid the effect of changing motor loads on lamps. Each of the four 10,000-volt transmission circuits leaving the generating station consists of three No. 2 bare wires of solid soft drawn copper. Each of these wires is supported by Locke No. 16 glass insulators mounted on regular 1.5 inch locust pins. On one pole line the three wires of a circuit are arranged flat on a single cross arm, and on the other pole line two wires of each circuit are on one side of a lower crossarm and the third wire of each circuit is on an upper crossarm. Wires on the same crossarm are 18 inches apart and the upper crossarm is 24 inches above the lower. The wires are not transposed but maintain the same relative positions over the entire line. Neither pins, crossarms nor poles have been treated with any insulating or preservative compound. One pole line between the generating plant and the sub-station is located along a highway, and the other pole line partly on a private right of way and partly along another highway. The standard pole for these lines is of chestnut, 30 feet long, and with a 7-inch top. Poles of different lengths have been much used, however, where the lines go up and down hill in order to avoid sharp changes in the elevation of the circuits. This practice greatly reduces the strains on wire, insulators, pins and poles in a hilly country, and materially improves the appearance of the line. On straight runs these poles are set 110 feet apart, on curves 55 feet apart, and all sharp angles are made with two poles set 6 or 8 feet apart. Poles at sharp angles all carry double crossarms so that the two poles give each wire four points of support. At a point where the transmission lines cross the Presumpscot River with a span of about 200 feet, two poles with double arms are used on each bank, so that the strain of each wire is taken by four pins and insulators. Guy wires of 7-16 inch galvanized and stranded iron cable, or else wooden struts, are used to support all corner poles. These guy wires are attached to poles directly beneath their lower crossarms and are said to give no trouble. On one of the pole lines a private telephone circuit connects the generating station at Great Falls with the sub-station at Portland.

The 10,000-volt transmission lines do not reach the city, but enter transformer houses outside of its limits. On one line the transformer house is about one mile and on the other line about four miles from the sub-station. At each transformer house the 10,000-volt pressure is reduced to 2,500 volts and the separate circuits pass on to the sub-station at this voltage. One of these transformer houses contains three oil-insulated transformers of the Wagner make and rated at 150-kw. each. At the other transformer house there are six transformers of 200-kw. each, made by the General Electric Company, three of these transformers being cooled with air and three with oil. The fourth set of transformers for the fourth transmission circuit is not yet in position.

About one mile from the business center of Portland is the sub-station to which the 2,500-volt transmission lines from the two transformer houses come. The transmission circuits are connected through General Electric *C R* regulators to separate sets of bus bars at the sub-station, and from these bus bars the distribution circuits for power service, street lamps and for commercial lighting go out at about 2,500 volts, three-phase. One set of circuits is devoted exclusively to street lighting, another to motive power, and a third to commercial lamps. Motors of less than one horse-power capacity are in some cases connected to the commercial lighting circuits. The sub-station contains one 250-kw. three-phase, 60-cycle generator connected by rope drive with a 250-horse power engine of Armington & Sims make. This generating set is used occasionally on Sundays when work is being done on the transmission lines, but is not intended to provide for lack of water power, its capacity being too small for any such contingency. Moreover, the water power has thus far proved ample for the loads at all times of year. Besides this generating set the sub-station contains a 200-horse power 2,500-volt three-phase, 60-cycle induction motor of General Electric make, connected at each end of its shaft to a Brush arc dynamo of 8,000 volts and 6.6 amperes capacity. These two arc dynamos are devoted to the operation of enclosed arc street lamps. One constant current transformer in the sub-station is devoted to the operation of series incandescent street lamps. At other points in the city four constant current transformers of 6.6 amperes and 4,000 volts each are devoted to street lighting, being fed by the 2,500 volt circuits.

The circuits of the Portland Lighting & Power Company now supply 36 motors with an aggregate capacity of 835 horse power, the largest of these motors being rated at 300 horse power. All these motors are of the induction type, three-phase, 60-cycle, and are supplied through transformers from the 2,500 volt lines. Most of these motors were made by the General Electric Company.

It may be noted that the average size of these motors is unusually large for an electric supply system, being 23 horse power, or if the one 300 horse power motor is omitted, the average capacity is 15 horse power. This comparatively large average capacity for motors and also their large total capacity indicates that the low power rates made by the Portland Company are forcing motors into many factories and buildings where steam engines would ordinarily be employed. The street lighting circuits of this system supply 302 enclosed arc street lamps. The commercial circuits supply 50 enclosed arcs and about 20,000 incandescent lamps of 16 candle power for interior use. Most of this load has been secured since construction was begun on the new station at Great Falls in the Spring of 1899. It is interesting to note that the power factor of this system is raised by operating the 200 horse power motor at the sub-station without load during hours when street lamps are not wanted.

The construction of the foregoing system has been engineered and its successful business policy carried out by Mr. E. H. Mather, its treasurer and manager, who has kindly furnished the materials for this sketch.

Present Status of Electric Automobilism.

BY HAYDEN EAMES.

WE often see the statement made in the public prints that much engineering development will still be required before the automobile can be regarded as a commercial success, the implication being that the available automobile of today is not adequate to the economical performance of the commercial service to which it is proposed to apply it. Even in conspicuously accurate financial papers we see such statements as "There are many problems of construction and mechanical device to be solved."

ELECTRIC EXPRESS DELIVERY WAGON.

Nothing could be more erroneous. The electric automobile express wagon and delivery wagon are to-day in a position to very much more than compete with present methods of transportation, considering first investment, expense and depreciation. The principal obstacle to the rapid introduction of the automobile lies in the misconception of the public as to what it can do and what part it may be expected to play generally in contributing to its convenience.

These are not predictions. It is happily no longer necessary to state in the future tense the economical advantage of electric express and delivery service over that performed by horses, and the data is now so ample and so variously corroborative that to those informed its force is not impaired by the adverse results of the blundering experiments that have been made from time to time in the application of electrical automobiles to merchandise delivery. It is worthy of note that in the majority of cases the value of these experiments has been almost wholly destroyed either by the obtrusion of the advertising element as opposed to the utilitarian or by the readiness to sacrifice the conclusive nature of the experiment to a desire to make it at the least possible first cost.

HORSES.

Investment.		Annual Expense.		
3 wagons at $175	$525	Interest at 6%		$69.90
4 horses at $160	640	*Wagons:*		
		Deprec. at 10%	$52.50	
Total rolling stock	$1,165	Repairs at $35	105.00	
				157.50
		Horses:		
		Deprec. at 20%	$128.00	
		Feed, care, shoeing, & stable exp. at $28.75 per mo., $345; per annum	1,380.00	
		Blankets, stable fixtures, harness at $3 per mo., $36; per annum	144.00	
				1,652.00
		Men:		
		3 at $45 per mo.		1,590.00
				$3,469.40
Annual saving Electric over Horse Wagon				$1,470.90

ELECTRIC.

Investment.		Annual Expense.		
Total rolling stock	$1,925	Interest at 6%		$115.50
1¼ batteries at $500	625	*Batteries:*		
Wagon without battery	1,300	Electric current, care & renewals per annum		400.00
Motors	300	*Wagon:*		
Wagon & remainder of equipment	1,000	Depreciation of motors 5%		15.00
		Depreciation of remainder of wagon at 10%		100.00
		Mechanical repairs at $9 per mo.		108.00
		Men:		
		1 at $60 per mo.	720	
		1 at $45 per mo.	540	
				1,260.00
				$1,998.50

The enclosed comparative statement of the actual performance of a delivery wagon like that shown in the photograph herewith is a fair example of the nature of the data now available. Every item on this sheet is derived from actual performance with this wagon, except the figure for battery renewals, which is placed at $50 higher than one could have contracted for the care of such a battery six months ago. The terms of renewal offered by battery manufacturers continually improve and this figure, to be up to date, should be considerably reduced. As a matter of fact, the corresponding actual figure in this particular case, on the original terms as to renewal, amounted to $189 in ten months, and this included a complete renewal of positive plates. This performance is not as good as that of many other batteries that have come under my notice in service even more severe.

In making comparisons of the various kinds of power and in considering the question of electric delivery wagons generally, it seems to be generally assumed that as in the case of most apparatus, the cost of battery renewals will continue in a continually increasing scale until the time comes when the battery will be entirely destroyed in some mysterious and unspecified way and has to be written off to depreciation, due allowance being made for it in advance from time to time in figuring estimates. It only takes a moment's reflection to recognize how absolutely inaccurate such a statement is. The actual depreciation of jars and separators seems to be represented by nothing but the breakages in handling and cleaning, and each renewal of elements and parts thereof, if properly made, restores the battery almost to its original utility, and this occurs at *each* renewal. It is quite possible, even with the most ordinary care on the part of men of the education and class which it is economical to employ for this service, to have a battery, like the motors, "wear out" the rest of the structure, the only charge to the battery account being for current, cleaning, ordinary care and renewals. This item offers the principal advantage of the storage battery driven vehicle over the prime mover vehicle for express and delivery service in cities. We have yet to hear the most sanguine advocate of the prime mover vehicle fix a life of more than seven years (more frequently five) for the life of the prime mover and its attendant mechanism when used under the relatively speedy and severe conditions of urban delivery, at the end of which time repairs could no longer be economically undertaken.

This depreciation in a "prime mover" vehicle, at least, at the speeds required for the particular service referred to, must be accompanied by a further depreciation account for rubber tires, without which the depreciation of the mechanism itself must necessarily be enhanced. On the other hand, the experience of the last fourteen months has demonstrated conclusively that with proper designs of wheels and treads no form of rubber tire is necessary to the economical performance of the storage battery driven express wagon. The same experience has entirely disposed of the well-founded early impressions as to the difficulty of obtaining satisfactory traction with iron tires.

The economy of the electric automobile having been established over all other available methods of urban merchandise delivery, the burning question is how those interested can obtain in a reasonable time the tremendous number of vehicles which will be required in this country alone to supplant the horse in the transportation of merchandise? The simplicity possible in the electric vehicle makes available the only ready solution to this question. The inherited empirical knowledge of centuries has put the horse wagon and carriage manufacturer in a position to successfully cope with the unmeasurable and uncomputable inequalities of road service, and has enabled him to develop the most economical construction and methods of manufacture to meet these conditions. Any motive power, therefore, of which the horse carriage and wagon manufacturer can avail himself without serious departure from the general methods of construction and manufacture which he has so thoroughly developed, immediately makes available to those engaged in express and delivery service the same sources of supply for the power wagons as formerly were available for the horse wagons for which they will be substituted. It is very fortunate that the same form of power—the electric—meets this condition and is at the same time the most economical for the purpose to which it is to be applied. The importance of this can hardly be overestimated, not only from the point of view just recited, but also in its effect in preserving the value of those ready-made investments which otherwise will be greatly impaired by the general substitution of the automobile for the horse in merchandise transportation.

The above statements must not be construed as in disparagement of the economy of application of automobiles propelled by prime movers to those particular fields to which the electric vehicle is not adapted. To what extent future improvement in prime mover vehicles will extend their domain into that of the electric vehicle it is, of course, impossible to say, but the fact remains that the last two or three years' experience with the electric automobile, makes it possible to positively assert that it is to-day the most economical and convenient means for the wholesale transportation of merchandise and retail transportation of people in cities.

Three-Phase Measurements.

BY LESLIE L. PERRY.

I HAVE read with much interest the article on "Three-phase Measurements," by Mr. A. S. McAllister in your issue of December 13, but beg to differ from him when he states that "in interconnected polyphase circuits carrying unbalanced loads the power factor will have practically as many different values as there are terms by which it can be determined." I give below a method which I have never seen in print, by which the power factor of any three-phase circuit, no matter how unbalanced are the currents and voltages, can be calculated from the measurements of the three voltages, the three-line currents and the total watts of the circuit. The method shows that the term "power factor," even in unbalanced

circuits, has a very definite meaning.

To illustrate the method, I take Mr. McAllister's example:

Line Voltages.	Line Currents.	Total Watts.
$ab = 100$	$A = 26.45$	6,000
$ac = 100$	$B = 36.05$	
$bc = 100$	$C = 43.60$	

Forgetting for the time being that we know the watts let us find the relations of currents and voltages as follows: Construct a Y

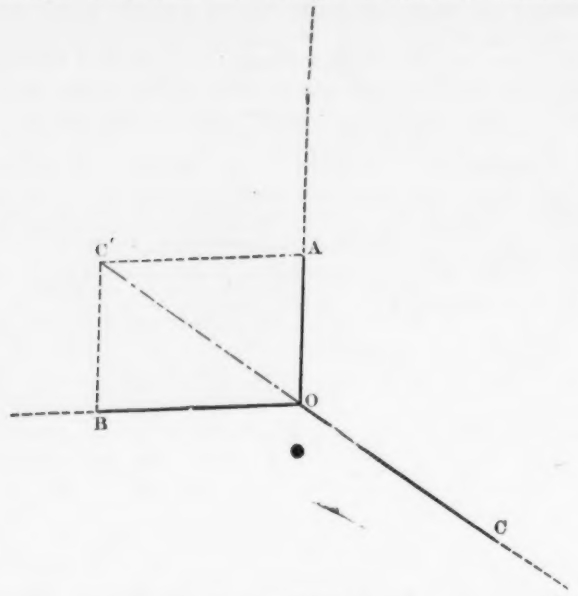


FIG. 1.—Y-DIAGRAM.

diagram of currents as in Fig. 1, by making triangle $C'\ B\ O$ where $B\ O$ = *current B*, $C'\ B$ = *current A*, $C'\ O$ = *current C*. Then carry $C'\ O$ to C, making $C\ O = C$ and $A\ O = A$. The Y will then give the currents in their correct phase relations, as their resultant must be zero. The voltages can now be made into a delta, as in Fig. 2.

The next step is to superimpose the delta of voltages upon the Y of currents, or more correctly, perhaps, upon the counter e.m.fs of the Y, which in non-inductive circuits are in phase with the currents. By drawing the delta on one piece of paper and the Y on another, a little manipulation will give the correct arrangement, where the vertices of the delta fall upon the legs of the Y, as shown in Fig. 3. Then following out diagrammatically the action occurring

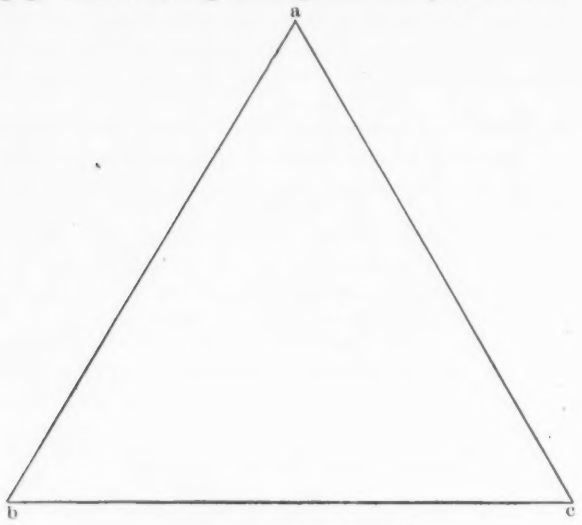


FIG. 2.—DELTA DIAGRAM.

in two wattmeters connected to indicate the watts of the circuit, project current $A\ O$ on voltage ab as at $a_2\ o_1$, current $C\ O$ on voltage cb, as at c_2, o_2, and we obtain as the watts,

$$a_2\ o_1 \times ab = 20 \times 100 = 2{,}000$$
$$+\ c_2\ o_2 \times cb = 40 \times 100 = 4{,}000$$
$$\text{Total watts} = 6{,}000$$

Similarly we can get for the other possible wattmeter connections,

$$a_2\ o_2 \times ac = 25 \times 100 = 2{,}500$$
$$b_2\ o_2 \times bc = 35 \times 100 = 3{,}500$$
$$\text{Total watts} = 6{,}000$$

and

$$b_1\ o_1 \times ba = 25 \times 100 = 2{,}500$$
$$c_1\ o_2 \times ca = 35 \times 100 = 3{,}500$$
$$\text{Total watts} = 6{,}000$$

This construction has been independent of the watts. Recalling now that the watts tested 6,000, we see that our assumption of non-inductive conditions was correct.

But now suppose with the same currents and voltages the watts measured 5,400, giving with the watts calculated by my method a power factor of 90 per cent., apparently, and a lag angle of 25° 51′. Then it is evident that the delta of voltages must be turned 25° 51′ ahead of the Y of currents, giving Fig. 4. Projecting the currents

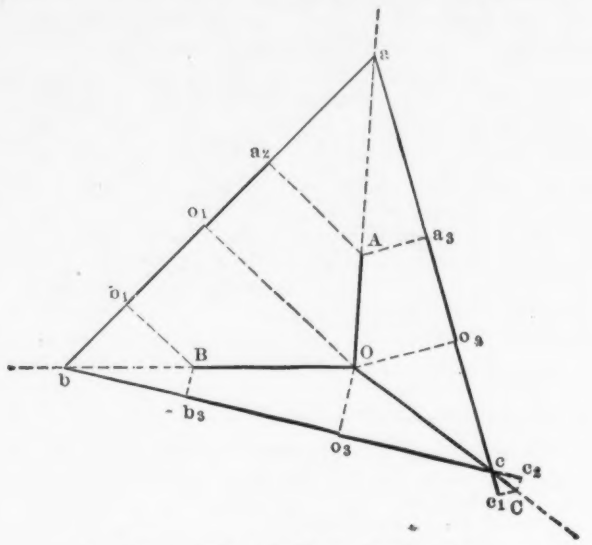


FIG. 3.—CURRENT AND VOLTAGE DIAGRAM.

on their corresponding voltages as we did before, we obtain from Fig. 4:

$$a_2\ o_1 \times ab = 33.8 \times 100 = 3{,}380$$
$$c_2\ o_2 \times cb = 20.2 \times 100 = 2{,}020$$
$$\text{Total watts} = 5{,}400$$
$$a_2\ o_2 \times ac = 10.4 \times 100 = 1{,}040$$
$$b_2\ o_2 \times bc = 43.6 \times 100 = 4{,}360$$
$$\text{Total watts} = 5{,}400$$
$$b_1\ o_1 \times ba = 26.3 \times 100 = 2{,}630$$
$$c_1\ o_2 \times ca = 27.7 \times 100 = 2{,}770$$
$$\text{Total watts} = 5{,}400$$

This checks with the measured watts and proves the correctness of the construction.

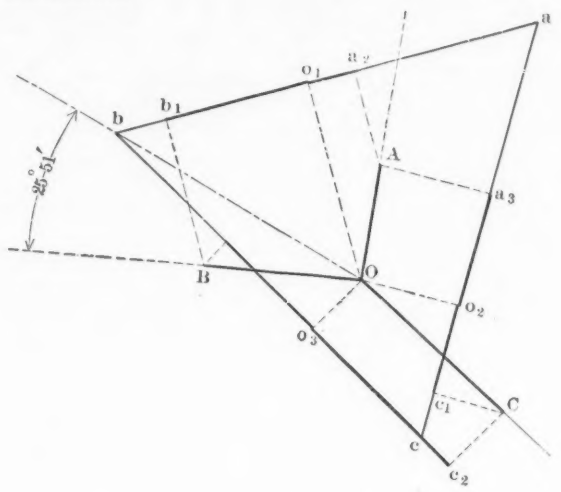


FIG. 4.—CURRENT AND VOLTAGE DIAGRAM.

In case, even, we assume zero power factor, that is zero watts, the volts and amperes being the same, we will find the method correct, for now the delta of voltages must be turned 90° ahead of the Y of currents, as in Fig. 5. It will then be found that in each pair of

products one has become negative and equal numerically to the other, giving a wattage of zero; thus

$$a_2\,o_1 \times ab = 17.3 \times 100 = 1{,}730$$
$$c_2\,o_2 \times cb = 17.3 \times 100 = 1{,}730$$

Total watts = 0

$$a_3\,o_3 \times ac = 8.7 \times 100 = 870$$
$$b_3\,o_3 \times bc = 8.7 \times 100 = 870$$

Total watts = 0

$$b_1\,o_1 \times ba = 26.0 \times 100 = 2{,}600$$
$$c_1\,o_2 \times ca = 26.0 \times 100 = 2{,}600$$

Total watts = 0

From the above I would define the lag angle of an unbalanced

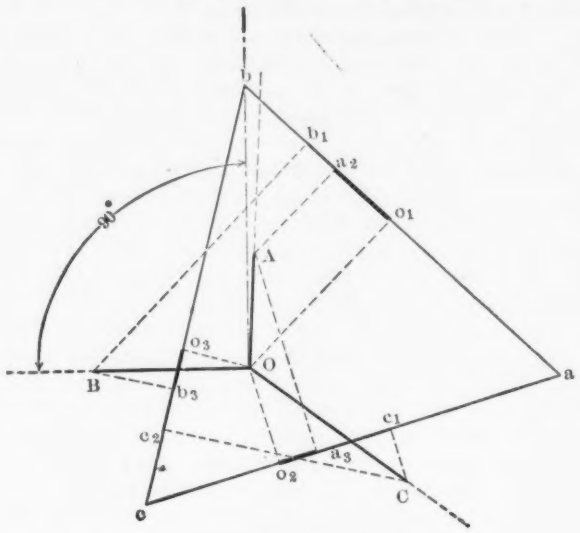


FIG. 5.—CURRENT AND VOLTAGE DIAGRAM.

three-phase circuit as the angle between the delta of voltages and Y of currents, and the power factor as the ratio of the actual to the apparent watts.

Hints on the Care of Electrical Equipment.

BY W. E. WITTER.

IN the lighting and power plant of a large factory, peculiar conditions often arise, with no solution of the trouble for awhile, occasionally requiring a great deal of study and examination, into the conditions as they were at the time of trouble, and what led up to it. If such information could readily be obtained, the solution of the problems would locate the fault at once; but it is seldom one can obtain such facts, and with only a slight clue, he must ferret it all out like a Sherlock Holmes. Some of these problems are as follows:

It was necessary to learn the cause of the burning out of a rotor of an induction motor, the motor having been repaired and put in place. In looking over the wiring, it was discovered there were two branches of the 110-volt lighting circuit arriving at the motor from two different sources, each two-wire circuit having a cut-out, and thence to a two-phase single-throw knife switch, thence to each phase of the 1-hp induction motor. Current was applied, but the rotor did not revolve. If either phase were open, the same condition would result. In the accompanying diagram, it will be observed that connecting a 110-volt lamp across 1—3 or 2—4 at the switch will indicate whether a fuse is blown, or if the circuit is open elsewhere.

It was found that both circuits were receiving current from the same phase, and by changing a double-throw switch, at the switchboard to another phase, the trouble was made right. To make similar tests on 440-volt power circuits for induction motors, connect four lamps in series and test across the blades of the switch at the motor or at the "auto." Sometimes the trouble is on the autostarter, when one of the blades is rough because of an arc, and does not allow the switch to enter far enough for all the blades to make contact, which would prevent the motor from starting. A fact which had puzzled the former electrician was that in testing from the rotor conductors to the core, the magneto rang. This he at first mistakenly took to mean a grounded armature, but is as it should be.

Next to be decided was the cause of a certain large induction motor stopping every once in awhile. Some said it was due to overload, others thought there was something wrong with the motor, and advised taking it apart to locate the trouble; but none of them were versed in the diseases of induction motors.

True, if the motor were heavily overloaded, it might stop; but as long as the voltage was kept normal, it would take four times the normal load to stop the motor, and in this case it was almost impossible to give it such a load. Besides, the motor was not overheated, being less than 20 degs. Centigrade above the surrounding air. It was rated at 114 amperes per phase, full load; but there were no meters at hand, so it was impossible to find out in that way what it was doing. The belt was just tight enough to prevent slipping, and its bearings were only reasonably warm. The aggregate load on the composite generator was at such times very much in excess of its capacity.

Therefore, while others were fixing their attention on the motor, the electrician was busy elsewhere, watching the instruments in the engine room, the men in charge being otherwise engaged. The electrician arrived just in time to discover that the generator voltage was far below normal. The engine had slacked up under its load, with the result that the voltage went down, and the motor had too much load to run on with so greatly decreased voltage. An attendant opened the motor switch just in time to save a complete tie-up on that feeder, which supplied other motors.

Elevators driven by induction motors next claimed attention. There came a report that a motor was burnt out and its elevator disabled. The even temporary loss of an elevator which is in constant use for getting out goods for shipment means considerable in a great establishment. The first decision, before the electrician came, had been to "take out the armature" and get it repaired. A hasty glance at the elevator controller revealed two burnt out coils, with the tape completely off the outside layers, and smoke still rising when the electrician arrivd. He cleared away the burnt stuff, filed and sand-papered the controller contacts, used a very little lubricant on the latter, tried the controller with the switch open, to see if it went "all on" and "all off." The coils had burnt out because the controller stuck and was running on the resistance. The dashpot was cleaned out and refilled with clean glycerine and water,

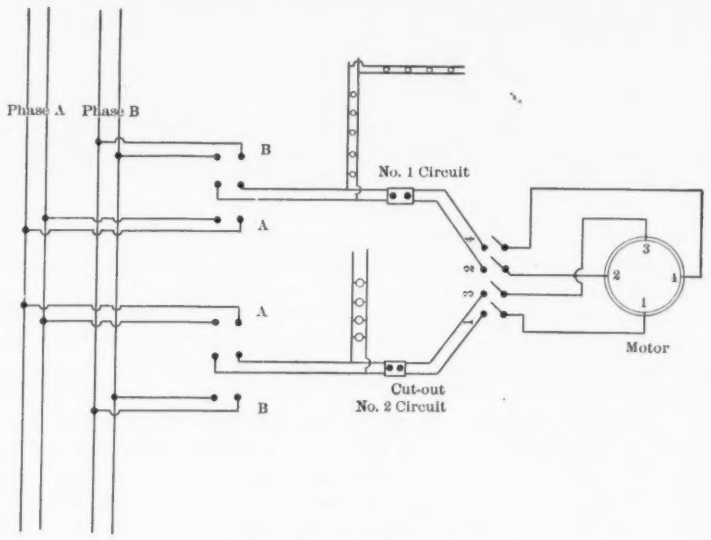


DIAGRAM OF CIRCUITS.

and then the controller worked all right on and off. The operator was advised to handle the apparatus as carefully as possible, and not put on heavy loads until the coils had cooled down. The result was, the elevator was kept in operation until quitting time, after which the coils were replaced with new ones. The workmen learned a point in connection with this repair job that they hadn't known before.

When the new coils were put in one of the workmen was surprised to find that the motor still did not operate right, and that the coils he had inserted got so hot on starting that they would have burnt out in a short time had current been applied longer. He

had put it in "wrong side to," reversing the current in the new coil, which gave a buck and stopped the controller at that point. He "couldn't see what difference that made"; but when the coil was changed, all was O. K. once more. These coils consisted of bare German silver ribbon, insulated between layers with thin mica. On one occasion two men worked continuously for twenty-four hours to take apart and put together an elevator motor, only to find that the armature was all right, and their work unnecessary. The peculiar mechanical construction, whereby the motor and elevator were coupled together in an almost inaccessible flange union, was what required so long a time for taking apart and replacing. The needless see-sawing of an elevator by a new man will always give more or less trouble. An operator should be given all the information possible, to avoid the shut-downs that will frequently occur with a new man, especially with a variable-speed elevator, induction motor, direct connected.

A direct-current lighting generator, compound-wound, which without warning suddenly determined it would produce no more light, puzzled the electrician sorely. He tried a two-ampere fuse across the leads of the brushes after the brushes were adjusted and the shunt field circuit closed. Not enough current was generated to melt this fuse; hence he decided that the armature was either short-circuited or open-circuited, but after a little more coaxing, the generator built up and ran all right the next night until nearly morning, when it stopped once more. Poor contacts in rheostat were looked for, and shunt connections examined. The motor was taken where it could be tested with current. By means of a water rheostat it was run as a motor for some time, proving that the armature was all right. The trouble was found to be due to a poor splice, consisting merely of wires twisted together and taped over. Some one had attempted to run the machine forward to take up the slack in the belt, putting a strain on the wire; and had probably used this method to cover up his tracks.

The next thing to be looked into was poor light in one or more of the buildings. It was found that one feeder was carrying just twice what it was rated at. A two-phase system was in use, induction motors being used to operate different floors, and the lights were tapped from both phases. The phases were practically balanced until the lighting load came on, when, in spite of attempts to keep it so, one transformer would get hot from overload. An extra transformer was installed, putting two in parallel on one phase, which necessarily required considerable changing of circuits to maintain a balanced load.

It is essential that the entire wiring of any building be done in the very best way possible. In a large plant some work will be slighted and slid over, in spite of inspection; but it should be followed up closely. The National Code can be very conveniently twisted by uninformed persons to suit different classes of work, and a man may even reason himself into thinking it will do even if it is not all right. Nevertheless, the company usually pays heavily for careless work.

Vapor-tight globes should be used where there are dangerous gases, and no switches allowed where the arc is liable to cause an explosion. In the plant herein referred to, it was found necessary to replace many lamps with vapor-tight globes, and to leave out fuses in various places, where link fuse cut-outs were in use. Enclosed fuses were used in dangerous locations, where link fuses were used before. In damp cellars, where brass sockets disintegrated because of dampness and gases, they were replaced by water-proof sockets. Extension cords were found under water tanks, where water trickled over them. Incandescent circuit wires were strung over belts, which would flap up and tear them loose; and instead of boring holes through the joists and inserting porcelain tubes for the wires, they had been connected in the same careless way, necessitating a periodical repair bill. Where gas was used for soldering purposes, lamp sockets were found tied to the gas pipes, and cords were hitched over in another direction, with a long piece of wire solder for a tie.

It kept one man busy in this department for awhile replacing fuses, on account of these conditions, and putting wires in order. A ground on the system was invariably found here. One four-story building, constructed entirely of ironwork, and in which oils were stored, had a main extending up to the fourth floor, with taps on each floor, with fourteen to seventeen lights on each circuit, with but a five-ampere single-pole switch controlling each floor circuit. The wires were strung mostly on knobs. A boy reached for a lamp one day, and couldn't get away from it. His cries drew the attention of the men, who had to run to the engine room, 600 feet away, to have that circuit opened. The single-pole switch was wrong in the first place, as there were more than six lamps on the circuit. Each should have been 10-ampere double-pole.

Wires crossed iron pipes in all directions without protection. One cannot be too careful in such work. A change was made where a 440-volt power line ran along the side of a room which was constantly flooded. The wires were covered with wood guards, and a doorway made to get at the fuses. A constant stream of water ran down over these, and the asbestos covering on the inside of the door was saturated and ready to drop off. A few feet away, the wires extended up to the next floor, and practically no water reached this place. The cut-outs were removed to this riser, and no further trouble experienced there. No man cares to replace fuses where no switch is at hand, even on a 400-volt circuit, if he must stand in water during the operation.

Careful and intelligent inspection will bring to light many possible improvements in almost any large plant. Some plants in which the system is large enough and the processes are more or less fraught with danger, employ a daily inspector. Included in his duties is the inspection of all wires. Pipe-men and carpenters often raise havoc with wires of all sorts which are in their path of work. One threw a lamp cord over a revolving shaft; and a ground on a wire was traced to a lamp dropped into an oil drip pan, up among shafts and gears.

Leave out knots in the cords, and should a lamp socket break off and hang down on the flexible wire on a side wall bracket, fix it at once. Do not let the wires on a portable desk lamp become so badly worn that it will short-circuit itself. Shades that perch rakishly on one side, like the hat of Happy Hooligan, should be straightened out and fastened so it cannot occur again. Lamp switches that light only after a dozen turns, or perhaps not at all, and loose fuse terminals in cut-out blocks which cause a fuse to get hot and blow when most needed, should be promptly corrected.

These may seem small affairs; but when the small leakages of a great factory multiply the result is very considerable. Look after the "stitches in time"; keep up the little repairs, and in the majority of cases, the large ones will take care of themselves. Moreover, careless work is not business-like, and should in any case be avoided.

Joliet-Chicago Transmission Started.

The 31,000-volt transmission from Joliet to Chicago, to supply power for operating the Bridgeport pumping station of the Illinois-Michigan canal, was put in operation last week. This is the first high-tension transmission line to enter Chicago. The power comes from the plant of the Economy Electric Light & Power Company, at Joliet, which is a water power plant operating mainly with water derived from the flow of the Chicago drainage canal. Thus Chicago sends waste water to Joliet and has it returned in the shape of electrical energy. The transmission distance is about 30 miles. The three lines are No. 2 solid copper carried on glass insulators, all three on one crossarm. The pole line follows the line of the canal. The Bridgeport pumping station formerly was operated by steam and played an important part in the sewage disposal of Chicago, as it pumped the Chicago River into the Illinois-Michigan canal, keeping the flow of the river away from the lake and causing the greater part of the sewage to flow away by the Illinois-Michigan canal. The pumping was done by a row of marine type engines coupled to centrifugal pumps located in the dam between the river and the canal. Since the completion of Chicago's great sanitary canal the necessity for so much pumping at the Bridgeport pumping station has disappeared, but the Illinois-Michigan Canal Commission must still keep this latter canal supplied with water, and to enable this to be done more cheaply than formerly, a contract was made for the power transmitted from Joliet. The load is an ideal one for a water power plant, for it is as constant as the water power itself.

There are installed two 300-hp 60-cycle 2,200-volt 3-phase induction motors of the internal starting resistance type. One of these is located in each end of the power house, which is located on the dam. The motors are belted to a line shaft running the length of the power house and from this shaft a number of centrifugal pumps in the dam are belted. The shaft is divided into sections by clutches, thus making a very flexible arrangement.

Washington Meeting of the American Association for the Advancement of Science and of the Affiliated Societies.

BY N. MONROE HOPKINS.

THE fifty-second meeting of the American Association for the Advancement of Science and the Affiliated Societies, held in the various buildings of the Columbian University, Washington under the presidency of Dr. Ira Remsen, proved without question the most successful in the history of the organization, and brought together the largest number of scientific men of note that have ever met in this country.

This is the initial meeting of the American Association during the holiday season in conjunction with all the affiliated societies, and the credit for this accomplishment is due to a special committee of the Association, of which Dr. Charles S. Minot, of Harvard University, is the chairman. This committee secured from all the leading colleges and universities throughout the United States their consent either to lengthen the holiday vacation or to arrange so that all professors may have the necessary leave of absence to attend.

From December 29 to January 3 had been named as convocation week and the experiment of meeting in midwinter as one great unit has proven so very successful that it will undoubtedly continue as the regular meeting scheme of the Association and the affiliated societies hereafter. The attendance of the Association alone at this winter meeting numbered 975, as against the 475 of the Pittsburg meeting last year, and with the registration of the affiliated societies added, the number reached 1,337, as compared with the 635, which was the sumtotal of the American Association and affiliated societies at Pittsburg. In adding the number registering in the affiliated societies care has been taken not to include those who are members of both the Association and of the affiliated societies.

There have been 375 new members elected since the Pittsburg meeting and 50 members were elected Fellows at this Washington meeting. Five hundred and forty-three papers were presented at this meeting, showing an increase of 183 over the meeting last summer.

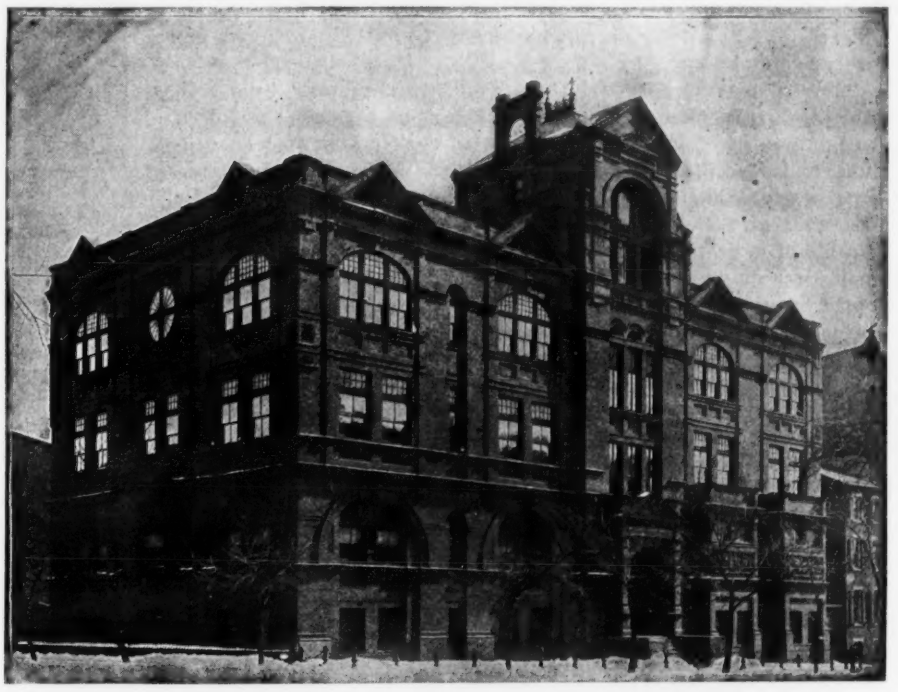
It is of interest to note that the American Association has increased its membership by about 1,500 in the last eighteen months, the growth resulting from the united expansion of its ten sections in a remarkably well balanced manner, until to-day there are over 3,700 Fellows and members. The Association has 51 published volumes and is without doubt the largest scientific body in America.

The present convention was called to order on Monday morning, December 29, by the retiring president, Professor Asaph Hall, U. S. N., who introduced the president-elect, Dr. Ira Remsen. Addresses of welcome were made by Dr. Charles W. Needham, President of the Columbian University, on behalf of the educational institutions of Washington; Charles D. Walcott, on behalf of the Washington Academy of Sciences; Hon. B. F. Macfarland, on behalf of the District of Columbia, and the Hon. David J. Hill, on behalf of the National Government.

The addresses were responded to by President Remsen, which response was followed by announcements from the general, permanent and local secretaries, including statements as to the honors of meeting and adjournment of the general session. Then followed registration and organization of the sections and societies in their respective halls, provided for by Professor Charles E. Munroe, Chairman of the Committee on Meeting Places and Equipment.

Upon organization, which consumed the remainder of the forenoon, a luncheon was given to all the visiting scientists by the local committee. Monday evening the retiring address was delivered by Professor Hall. Among the social features of the convention may be mentioned the various dinners and smokers given by the numerous societies, in addition to the general luncheon noted. There were few visits to places of interest at this meeting, most of the time being given up to papers and business, even on New Year's Day the sections meeting as usual. Among the visits made, however, may be mentioned the reception by the President of the United States on Saturday morning, and a visit to the plant of the Columbia Liquid Air Company, where the machinery was seen in operation and liquid air exhibited and experimented with.

The place of meeting for next year and the officers for this meeting were chosen on Friday evening as follows. Meeting place, St. Louis. President, Dr. Carroll D. Wright, of the Department of Labor, Washington, D. C. Vice-Presidents—Section A, Mathematics and Astronomy, O. H. Tittman, Superintendent United States Coast and Geodetic Survey; Section B. Mathematics and Astronomy, Edwin H. Hall, of Cambridge, Mass.; Section C, Chemistry, W. D. Bancroft, of Ithaca, N. Y.; Section D, Mechanical Science and Engineering, C. M. Woodward, of St. Louis; Section E, Geology and Geography; I. C. Russell, Ann Arbor, Mich.; Section F, Zoology, E. L. Mark, Cambridge, Mass.; Section G, Botany, T. H. Macbride, Iowa City, Ia.; Section H, Anthropology, M. H. Saville, of Museum of Natural History, New York; Section I, Social and Economic Science, S. E. Baldwin, Supreme Court of Errors, New Haven, Conn.; Section K, Physiology and Experimental Medicine, Prof. H. P. Bowdich, Jamaica Plain, Mass. Permanent secretary, Dr. L. O. Howard, Washington, D. C.; general secretary, C. W. Stiles, Washington, D. C.; secretary of the council, C. S. Howe, Cleveland, Ohio.



COLUMBIAN UNIVERSITY, WASHINGTON, D. C., "HEADQUARTERS," A. A. A. S. MEETING.

In view of the meeting place being Washington this year, and the election of Carroll D. Wright, of Washington, to the presidency for next year, it may be of interest to note the number of past presidents who have been elected from Washington. They are: Simon Newcomb, S. P. Langley, T. C. Mendenhall, William Harkness, Theodore Gill, and G. K. Gilbert, and with the election of Dr. Wright at this last meeting, the list makes a most favorable showing for Washington as a scientific center.

Among the affiliated societies which met with the American Association during convocation week may be mentioned the following: American Anthropological Association, American Chemical Society, American Folk-Lore Society, American Morphological Society, American Philosophical Society, American Physical Society, American Physiological Society, American Psychological Association, American Society of Naturalists, Association of American Anatomists, Astronomical and Astrophysical Society of America, Botanical Society of America, Botanists of the Central and Western States, Geological Society of America, National Geographic Society, Naturalists of the Central States, So-

ciety of American Bacteriologists, Society for Plant Morphology and Physiology, Society for the Promotion of Agricultural Science, Zoologists of the Central and Western States, American Alpine Club, National Association of State Universities, American Microscopical Society, Society of Economic Entomologists.

Among the papers presented at the Washington meeting may be listed the following of interest from the physical or electrical engineering standpoint:

"A Systematic Method of Calculating the Dimensions of Dynamo-electric Machines," by Carl Kinsley, University of Chicago. The paper deals with dimensions so arranged that a set of three simultaneous equations gives the relations existing between the diameter of the armature, its length, and the number of conductors on the winding. These equations are primarily made to depend upon considerations which will determine the satisfactory operation of the dynamo. The first equation is made to depend on the electromotive force desired. The second equation considers the rise in temperature allowable. The third equation determines the efficiency of the machine. The intermediate assumption, such as the area covered by the pole pieces, affect the ultimate dimensions, but all unite in giving the essential features desired, namely, the electromotive force, rise of temperature and efficiency.

"Exhibit of a New Mechanical-Metallurgical Product in Copper," by C. A. Waldo, Professor in Purdue University, Lafayette, Ind. The paper is descriptive of a hollow copper ball of uniform thickness and predetermined weight and strength, made by an entirely original process.

"The Construction of a Sensitive Galvanometer," by C. G. Abbott, Smithsonian Institution, Washington, D. C. This paper will be published in the Proceedings of the Smithsonian Institution, and describes what is probably the most sensitive galvanometer ever constructed. The instrument has sixteen coils, and a resistance of 1.6 ohms. Its constant is 5×10^{-11} ampere, and is capable of indicating a current as small as 1×10^{-12} ampere. This paper was given with an introduction by S. P. Langley, Secretary of the Smithsonian Institution.

"The Condition Governing the Coherence of Metals When There is an Electrical Discharge Between Them," by Carl Kinsley, University of Chicago. The paper describes an apparatus for studying coherence effects between surfaces whose distance apart could be measured to a .04 of a wave length of light. Prof. Kinsley also read a paper on "The Determination of the Frequency of Alternating Currents by the Automatic Adjustment of the Circuit to Resonance."

"Experiments Concerning Very Brief Electrical Contacts," was the title of a paper by Herschel C. Parker, Columbia University, New York, which gave an account of experiments concerning very brief electrical contacts by means of a gravity contact key.

"Derivation of Equation of Decaying Sound in a Room and a Definition of Open Window Equivalent of Absorbing Power of a Room," by W. S. Franklin, Lehigh University, consisting of a mathematical discussion on acoustic properties of rooms and halls in which the interesting point is brought out that theory agrees with experiment. Deals fully with absorption of sound by walls and objects in a room.

A paper "On the Velocity of Light as Affected by Motion Through the Ether," by Edward W. Morley, Western Reserve University, and Dayton C. Miller, Case School of Applied Science, referred to experiments which will involve a year or more for their performance. The paper describes some new points in the theory, and it reported that the experimental work so far carried out gives promise of important discoveries.

A paper "On the Distribution of Pressure Around Spheres Moving With Constant Velocity," by S. R. Cook, Case School of Applied Science, is a mathematical discussion, and although very valuable, not of general interest.

In a paper entitled "Damped Ballistic Galvanometer," Prof. O. M. Stewart, of the University of Wisconsin, showed that, contrary to the usual supposition, the damped ballistic galvanometer gives deflections proportional to the quantities of electricity discharged through it.

A paper "On the Electrical Conductivity of Solutions in Amyl Amine," by Louis Kalenberg, University of Wisconsin, contains a description of a form of cell for investigating conductivity of solutions when the solvent is expensive or difficult to obtain in large quantities. It gives the results of solutions in amyl amine, a solvent whose dielectric constant is of the order of chloroform.

"On the Thermal Conductivity of Glass," a paper by H. W. Springsteen, Case School of Applied Science, describes measurements made on different samples of glass, the determinations being obtained through the agency of a thermo-electric couple.

Mr. Charles K. Wead, United States Patent Office, read a paper "On Some Relations Between Science and the Patent System," in which he called attention to certain unique opportunities for research afforded to the public by the Patent Office and by its publications.

"Why the E.M.F. of the Daniell Cell Changes When the Densities of the Solutions Change," was the title of a paper by Prof. Henry S. Carhart, University of Michigan, in which it was shown that the thermal change is abundantly large to explain the changes mentioned in the title. Prof. Carhart also read a paper on "The Absolute Measurement of the E.M.F. of the Cadmiun Cell," in which Prof. Karl E. Guthe, University of Michigan, collaborated. The paper described the preparation of the materials for use in the cadmium cell and an electro-dynamometer for making accurate measurements.

"The Coefficient of Expansion of Some Alloys of Nickel and Cast Iron," by Theo. M. Focke, Cleveland, Ohio, was the subject of a paper describing experiments which show that an alloy of 36 per cent. of commercial nickel and 64 per cent. of common cast iron make an alloy whose coefficient of expansion is about one-third of that of iron. This material has been used in making engineering instruments.

Prof. R. H. Thurston, Cornell University, in a paper entitled "Sulphur Di-Oxide and the Binary Vapor Engines," described the condensation of steam by sulphur-dioxide, and the utilization of the expansion of the sulphur-dioxide gas in a separate cylinder, thereby increasing the efficiency of the engine.

A paper by Prof. E. Rutherford, of McGill University, described the phenomena of "The Magnetic and Electric Deviation of the Easily Absorbed Rays from Radium."

A paper on "A Lecture Room Method of Analyzing Irregular Electric Currents," by Prof. W. J. Humphreys, University of Virginia, described an arrangement of a small gas chamber built upon an ordinary telephone receiver, with a pipe leading thereto. The vibrations of the diaphram affected a jet of gas which was lighted at the small opening provided. A revolving mirror apparatus completed the equipment.

Four papers dealing with radioactivity were as follows: "A Penetrating Radiation from the Earth's Surface," by E. Rutherford and H. L. Cook, McGill University. "Induced Radioactivity Excited at the Foot of Water Falls," by J. C. McLennan, Toronto University. "Note on the Possible Cause of Radioactivity," by Carl Barus, Brown University. "Radioactivity of Freshly Fallen Snow," by S. J. Allen, McGill University.

Among other papers read were the following: "Certain Data Bearing on the Occurrence of Lightning," and "The Electrical Charges of Water Nuclie," by C. Barus, Brown University. "The Critical Current Density and Drop of Potential at the Cathode in Vacuum Tubes," by C. A. Skineer, University of Nebraska.

"On the Double Refraction of Dielectrics in a Magnetic Field in a Direction at Right Angles to the Lines of Force," by L. T. Brace, University of Nebraska.

Indicting Brooklyn Trolleys.

The December Grand Jury in Brooklyn has presented a report to Judge Aspinwall on the conditions existing on the Brooklyn Rapid Transit lines. The presentment recites that the Grand Jury found poor light in the cars and insufficient heat. It also found that there were not enough cars run during the non-rush hours. The Grand Jury recommends that the Aldermen pass an ordinance compelling the company to properly light and heat its cars and to run more cars during the non-rush hours. On account of what it regards as the neglect of the public, it recommends that the Attorney-General be instructed to bring proceedings to annul the charter of the subsidiary lines of the Brooklyn Rapid Transit. It also recommends that the city of New York take over these lines and operate them. The Grand Jury says that it has examined officers of the company and found them unwilling to do what they could do to improve conditions. The presentment calls attention to the tendency towards an increase in immorality and pickpocketing as a result of the crowded conditions on the surface and elevated roads.

Arnold Report on the Chicago Transportation Problem.

The report of Mr. B. J. Arnold, to which we referred last week, comprises an octavo volume of 310 pages, accompanied by fifteen sheets of curves and a case containing fourteen maps. The report is divided into six parts and appendix, and is prefaced by a summary of conclusions and recommendations, which are printed below.

A general discussion of street railway systems and the conditions governing them forms Part I of the report. Part II discusses the inadequacy of present terminals and service and contains recommendations for improvement under divisional ownership. The discussion includes a consideration of the present terminals in the business center, the uses made of the same and their inadequacy; reasons for the inadequate service being furnished at the present time and reasons for dead trackage in the downtown district; how electric terminals were granted in the business center; reasons why cable operation as a system and operation of cars in trains should be abandoned; conclusions as to what should be done to better conditions under the present system of divisional operation by separate managements; discussion of the relative merits of overhead and underground conduit types of electrical construction; recommendations for an arrangement of loop terminals to take the place of the present terminals, and recommendations as to the disposition of the present terminals, with estimates of the capacity required of terminals; recommendation of a system of routing to eliminate largely the use of transfers; reasons for the desirability of double-truck cars; teaming conditions and their influence on car traffic; speed of cars, with reasons for not further limiting the speed; report on the system of transfers in use, and recommendations for the building of additional tracks to better serve the public.

Part III treats of the growth of population and development of the transportation business, with a discussion of probable future increase and an analysis of capitalization and financial results obtained in past operations. Twenty-eight charts of curves are included, based upon population statistics of Chicago and several of the metropolitan cities of the world. The heads of this section are as follows:

Population by divisions in tables and graphically for ten years from 1892 to 1901, giving percentages of increase and decrease, track mileage and population per mile of track, revenue passengers carried by divisions, rides per capita per annum, passengers carried per mile of track, gross passenger receipts per year, per mile of track per year, and per car mile operated per year; tentative conclusions regarding future population of Chicago and probably future earnings of railway companies; statement of operations for last fiscal year and analysis of existing capitalization.

Part IV is on through routes, universal transfers and the one-city-one-fare question. It treats of the relative merits of operating cars over through routes as compared with downtown terminals, discusses the subject of universal transfers and the question: Could a unified company afford to conduct the transportation business of Chicago on a one-fare basis?

Part V consists of the discussion of a new, reorganized and unified street railway system for Chicago and recommends a general plan of surface transportation under a unification of control of the Chicago City Railway Company, the Chicago Union Traction Company, the Chicago Consolidated Traction Company and the Chicago General Railway Company, utilizing subway and surface terminals in the business district and routing cars through all divisions; a general plan is given of subways required for such operation, with an outline of the use of transfers, and a schedule of routes recommended, showing length of routes, time, number of cars and headway of cars; also a schedule of streets on which tracks should be built in the creation of such a system, showing distance and type of track construction; estimates are submitted of the cost to produce the system ready for the operation of cars, and an estimate of the earnings to be derived from the operation of such a system, based on the past performances of the present companies.

Part VI comprises various technical problems, valuations and estimates, and is divided in six chapters, as follows: Chapter I, subways. Chapter II, underground electric conduit system. Chapter III, electrolysis. Chapter IV, Union Elevated Railroad loop. Chapter V, track rails and track construction, with illustrations. Chapter VI, unit-price estimates. Chapter VII, valuation estimates. Chapter VIII, valuation of lines under expiring grants. Chapter IX, cost estimates.

The appendix gives tabulated information concerning present routes, length of round trip, time, and maximum number of cars operated by the Chicago Union Traction Company and the Chicago Street Railway Company; recommendations as to routes in the business district for the operation of cars under divisional ownership with joint use of tracks, reference being made to an accompanying map; recommendations for the operation of cars under a unification of management of the Chicago Street Railway and the Chicago Union Traction Company; schedules showing points at which transfers are issued and received by the Chicago Street Railway and the Chicago Union Traction Company; list of streets on which tracks are laid, with the distances in feet of street and single track; recommendations as to the streets on which to construct tracks, showing mileage and giving amount to be constructed in subways and amount of underground conduit type.

The engraved plates at the end of the book give cross sections of proposed subways, double-track subway stations, underground conduit railway construction and further population curves.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

I. THE ONE-CITY-ONE-FARE IDEA.

Chicago, with respect to transportation as well as other things, should be regarded as one city, not three. Divisional lines ought to be obliterated, as far as possible. A street car passenger should be carried over the most direct route between any two points within the city limits for a single fare. Complete unification of ownership and management is the best plan for realizing the one-city-one-fare idea. The same end can be accomplished, however, but in a less satisfactory manner, under divisional ownership, by a plan of through routing of cars, joint use of tracks and interchangeable transfers. To a still less satisfactory degree the same end can be accomplished by the interchange of transfers between companies without joint use of tracks.

II. THE THROUGH-ROUTE PRINCIPLE.

Routes through the business district ought to be substituted for downtown terminals, wherever possible. Outside the business district, too, the best results would follow from connecting together the detached lines now found on several streets and operating cars over such lines from end to end on the through route principle.

III. SUBWAYS.

A system of subways should be, and eventually must be, built to accommodate the street car traffic of Chicago and relieve the street surface congestion in the business district. Galleries should be provided in connection with such subways for the accommodation of present and future underground utilities. Two subway plants are outlined in the report. One plan, referred to as Subway Plan No. 1, shown on map No. 11, calls for three north and south subways, from Fourteenth Street on the south to Indiana Street on the north, and two subways entering the business district from the West Side, utilizing the present Van Buren and Washington Street tunnels and looping back of Clark Street. This is a system of high level subways throughout, with no dips. Its estimated cost is $16,000,000. The other subway plan, known as Plan No. 2, shown on map No. 5, calls for practically the same north and south high level subways in combination with three or more low level subways from the West Side, passing under the north and south subways and reaching Michigan Avenue, and should future developments warrant, under Lake Front Park as far as it may be extended. The low level subways would require the use of elevators. The estimated cost of subways built according to this plan is $20,000,000. Plan No. 2 is recommended as best for the city from an engineering and transportation point of view, but in case this plan is deemed inadvisable for business or other reasons, a system of single-decked high level subways, as outlined in Plan No. 1, can be constructed, which will to a large extent accomplish the results. No subways should be built in such a manner as to preclude the operation of cars through them on the through route principle. Under either of the plans as outlined, the whole system of subways need not necessarily be constructed at once. One or more of the subways could be built at a time and utilized separately, but with a view to their ultimately forming a part of a

comprehensive system. The subway plans as submitted do not necessarily call for the removal of all tracks from the street surface in the business district, and Subway Plan No. 1 necessitates some surface loops. Under either plan there could be a street surface system connecting the depots and designed to accommodate short haul traffic in the business district. Under Plan No. 2 there could also be a low level subway system for connecting all depots, and by using it in connection with this subway all tracks could be kept off from the surface of the streets in the business district for some years to come.

IV. THE PRESENT RIVER TUNNELS.

It is inadvisable to attempt to lower the present river tunnels and at the same time retain them for surface railway use, for the reason that lowering the tunnels to a sufficient depth to accommodate future river traffic would involve extending the tunnel approaches at least a block further into the business district. In the interest of navigation, therefore, the tops of the tunnels ought to be promptly removed, leaving the lower parts of one or perhaps two of the tunnels for utilization later as parts of a future subway system.

V. PLAN FOR A UNIFIED COMBINED SURFACE AND SUBWAY STREET RAILWAY SYSTEM.

A plan is presented for a new, reorganized and unified combined surface and subway street railway system, comprising the lines of the City Railway Company, the Union Traction Company, the Chicago General Railway Company and the Chicago Consolidated Traction Company within the city limits, and new lines necessary properly to connect the now disconnected parts of the system. The total single track mileage of this system as outlined would be about 745 miles, and its estimated cost, if constructed new, with everything first class throughout, but exclusive of subways, would be $70,000,000. Adding $20,000,000, the cost of the subways constructed according to Plan No. 2, would make the total cost of the new system complete $90,000,000. With Subway Plan No. 1, instead of Subway Plan No. 2, the total cost of the new unified system would be $85,800,000.

VI. PLANS FOR IMMEDIATE IMPROVEMENT OF TERMINALS AND SERVICE.

Plans are presented for the rerouting of surface terminals in the business district, (1) under the present divisional ownership and operation, (2) under the joint use of tracks in the business district under divisional ownership, and (3) under unified ownership and management. Immediate improvement of Chicago's local transportation facilities may be effected by substituting electric for cable power and routing cars according to any of the plans outlined, all cars from the West and North sides to enter the business district over bridges until such time as subways shall be constructed.

VII. ELECTRIC UNDERGROUND CONDUIT SYSTEM.

The operation of cars in Chicago by the electric underground conduit system is practicable and feasible. Overhead trolley construction should be prohibited within the area bounded by Twelfth Street on the south and the river on the north and west. Outside of the district named the objections to the overhead trolley are esthetic in nature, and it is for the city authorities to say—after a balancing of financial against esthetic considerations—how much, if, any, underground conduit construction should be required. The cost per mile of single track (track alone, including feeders), of electric conduit road construction would average $81,300 for a system covering the entire city, including feeder wire, but exclusive of the cost of power, rolling stock and paving of right of way. All conduit construction, however, within the business district would cost about $100,000 per mile, due to the numerous curves, large amount of special work required, and the extra cost of labor, due to the congestion within the district in which the work must be prosecuted. To either of the above figures should be added the cost of paving, as follows: Brick, $12,650; asphalt, $12,880; dressed granite, $18,400. Overhead trolley road construction would cost $20,836 per mile of single track, using the same weight of rail. It would cost nearly as much to convert the Chicago cable roads into electric conduit roads as to build new electric conduit roads.

VIII. GROOVED RAILS.

A grooved girder type of rail, of special design, is recommended for well-paved streets upon which cars operate often enough to properly clear the groove of dirt and ice. On outlying streets and on poorly paved and poorly maintained streets the girder type of rail should be maintained as best for team traffic, and the railway companies.

IX. ELECTROLYSIS.

The destruction of underground utilities from electrolysis is now well in hand by the city, and if the present ordinance governing the subject is enforced no serious difficulties may be anticipated from this source, and when the underground conduit system is adopted there should be no further injury from electrolysis in the area served by the conduit system, because this system uses a complete metallic circuit.

X. THE FINANCIAL ASPECT OF THE ONE-CITY-ONE-FARE PLAN.

A unified company could afford to conduct the transportation business of Chicago on the basis of a single fare for a continuous ride anywhere within the city limits. The present divisional companies by the interchange of transfers, could afford to do the same thing, provided they were properly protected against the fraudulent use of transfers, but it would be at a somewhat greater cost to themselves, and with greater inconvenience to passengers. than would be the case under unified management.

XI. GROWTH OF POPULATION AND TRAFFIC IN THE PAST AND ESTIMATES AS TO THE FUTURE INCREASE OF STREET CAR TRAFFIC.

The population of Chicago has increased since its incorporation in 1837 to 1902 at the rate of 8.6 per cent. per year compounded, and is now increasing at the rate of 7.7 per cent. per year. For the nine years from 1892 to 1901, inclusive, the number of revenue passengers carried by the Chicago surface and elevated lines combined has increased at the rate of 5 per cent. per annum compounded. The increase for the surface lines during the same period has been at the rate of 1.5 per cent. per year compounded. The increase for the combined surface and elevated lines from 1894 to 1901, inclusive, a period of seven years, has been at the rate of 6.3 per cent. per year compounded. The increase for the surface lines alone during the same period has been at the rate of 3.9 per cent. per year compounded, and the increase for the elevated lines alone has been for the same period at the rate of 2.6 per cent. per year compounded. The population of Chicago has increased more rapidly than that of any other city in the world, but it is improbable that this rate of increase should continue indefinitely. Figures and curves are presented showing the past growth of Chicago as compared with other cities, also the future results if present rates of increase should be maintained, but as this is improbable curves are shown representing the increase in population and gross receipts that may reasonably be expected for the combined surface and elevated railways during the next fifty years.

XII. ESTIMATED COST OF REPRODUCTION AND PRESENT VALUE OF EXISTING PLANTS.

The cost to reproduce the following properties complete, with new construction and equipment throughout, would be: Chicago City Railway Company, about $17,200,000; Chicago Union Traction Company (not including the Consolidated Traction Company), about $22,200,000. The actual present value of the physical properties for railway purposes of the following companies, taking into consideration the obsolete equipment and construction which must be discarded, but not taking into account any franchise rights or earning capacity of the properties, is estimated as follows: Chicago City Railway Company, about $12,000,000; Chicago Union Traction Company (not including Consolidated Traction Company), about $15,000,000.

XIII. NEED FOR REGULATION OF TEAM TRAFFIC.

At the present time team traffic interferes with street cars to an unwarrantable extent. A reasonable regulation of team traffic is essential to the improvement of street car service.

XIV. THE UNION ELEVATED LOOP PROBLEM.

The junction points are the ultimate limiting factor of the capacity of the Union Elevated Loop. At the present time, however, the platform stations are the limiting factor. The first and simplest way to increase the capacity of the loop is to lengthen the station platforms so that two trains can load and unload to a station at the same time. When the capacity of the junction points is reached, added facilities can be provided by building stub-end terminals just outside the loop. The terminal capacity of the loop could be increased by dividing the present loop into four smaller loops, but presumably there would be public objection to such a plant, because it would involve encumbering more downtown streets with elevated structures, and it is, therefore, not recommended. The ideal solution of the elevated loop problem would be to utilize the loop structure as sections of through routes between the different sections of the city.

Experience With a Third-Rail Road in the Open Country.

BY CHARLES ESSELSTYN.

WHEN the Albany & Hudson Railway and Power Company completed its third-rail line, 36 miles long, between the cities of Albany and Hudson, and extending through a dozen villages and the city of Rensselaer, there were many who prophesied that for summer outings the road would prove a pleasant novelty and a picnic success, but that with winter weather the inevitable snows and sleets and landslides, as the track runs through a score of deep cuts and over a dozen newly built embankments, it would meet its Waterloo. Many of these Cassandras anticipated open cars and cooling breezes, and failed to realize that a railroad was being born, and not a city trolley system. They had hoped to climb into the back seat for a smoke, or to enjoy a chat with a friend, forgetting that their cigars would be blown from their mouths and their hats from their heads, when the power was on and the shoes were in place. They did not know that open cars had no right on a road where from 40 to 60 miles an hour was frequently the speed. When the opening day did come, when the big cars, to all appearances like the railroad coach, began a regular schedule, the city folk of Albany and Hudson, and the country folk of the adjoining counties of Albany and Columbia, began to appreciate that this 36-mile third-rail system was no toy, to be used merely for a picnic or an evening ride, but a real live railroad, built for business and calculated to make business. Instead of trolleys running at the pleasure of the motorman, they found a railroad time table which the descendants of the Dutch settlers gradually learned could be depended upon. Admiration followed amazement, and the road took its place as a real something to be used as a means of transit, and not as a target. But the Cassandras were not through. "Wait until the snow comes," they said, with the same confidence that the original had displayed in foretelling the troubles of Troy.

The third rail cars soon acquired a reputation for regularity, and to-day the company claims to run nearer to its schedule, with a smaller percentage of late trains, than any railroad, steam or electric, in this or any other country. And then the snows did come, and they have been coming ever since, but the interference with the schedule has been slight. A huge rotary plough and an ordinary one furnished the company's equipment to meet the white stuff which often lies a foot and a half deep on the levels and drifts to any depth in the cuts and on the open. The rotary has never been out of the car barns. At the first sign of storm the ordinary plough is prepared for work and after a few thin inches have fallen, it is started on its journey up and down the track. On December 13, when the railroads in the vicinity of Albany were blocked and the New York Central trains were six hours late, the Albany & Hudson kept its schedule to the minute, and all of that Sunday it was the only dependable means of communication between Hudson and Albany.

"But wait for the *sleet*," said the Cassandras, "then you will see the system go out of business." Sleet and rain which freezes as it falls was what the management feared. Thousands of dollars had been spent, it is said, in experimental investigations for the discovery of some successful plan with which to fight this common enemy. At last the management, despairing of the advice of experts, prepared a cast-iron block with blades, which was attached to the car just ahead of the front shoe; this was manipulated by air pressure, which received its power from the same air that controlled the brokes. It could be worked by a mere grip of the hand, pressed hard upon the rail, or elevated. The knives were set on the bias to the slightly raised third rail and were followed by a stiff brush. The first rain that fell and froze took the company unawares and there was a brief two-hour delay all along the line. From that day to this, that record has never been repeated or approached. Although there are some slight delays under abnormal circumstances, they arise from the fact that but two cars in the company's service are as yet equipped with the knives, and upon these two falls the duty of keeping the third rail free from ice. In the winter the service is only hourly, so that before the car second to the one with the scraper gets fairly on the line it sometimes happens that the rain has again taken hard hold of the cold third rail. If every car was equipped with this device or if the service was on a shorter headway, there would be no question of the thorough efficacy of the invention in use on this road, and the delays of a few minutes which now arise would be entirely done away with. The car with the blades makes its time, the car following does, but the car an hour after these sometimes finds the rail with a fresh coating of this cold varnish which cannot be shoveled or brushed off, and only succumbs to the knife. Dr. Lorenz's methods would fall short in this crisis, which needs something lethal.

The practical working of the road under adverse conditions has driven the prophets of evil to the pawnbroker. They realize that the third-rail system between Albany and Hudson differs materially from those run by "hot air" on the products of a wood pulp mill. With the rest of the country people, they are learning that it is quite safe to set one's watch by a third-rail train, and that even on days when the rain is freezing and thesteam trains are falling behind time, there will not be much detention on the electric system, where the untutored farmer's sons control the power and collect the fares, and the station agents and managers have not even the stimulus of the bustle of a big city to urge them to the mark.

A block system, it may be incidentally noted, has recently been installed, which, while not electric, works satisfactorily and seems guaranteed to prevent rear end collisions. By it no train can leave a station until the station master has been notified of its predecessor's arrival at the next station and in case of the absence of the station master the conductor must call up the train despatcher at Rensselaer by telephone, with which each station is equipped, and receive his permission to proceed. The road will be double tracked next spring from Electric Park, which is midway between Albany and Hudson, to Albany, thus enabling it to increase its summer service, which was tested to its capacity last season.

Besides the passenger traffic, the management has to take care of a large freight business that includes carrying farmers' products to market and the outputs of a score of mills, which sustain the thriving villages along the railroad's route. The installation of the third-rail system revolutionized this trade, gave an increased value to the farm lands, and an invitation to manufacturers that is being rapidly accepted. How they managed before is now the wonder of those dependent upon it, and while mishaps have come, as they must to all enterprises going into a new field, the Albany & Hudson Company is doing a mighty work in building up and making stable the country through which it passes. It is working out its own salvation in summer and in winter, in sunshine and when the sleet freezes, in a manner calculated to give it a prominent and lucrative field to live on and thrive in.

Trolley Mileage in Connecticut.

The annual report of the Connecticut Railroad Commissioners shows that during the last seven years trolley mileage in Connecticut has grown from 317 to 517 miles. The capital stock was $8,604,240 in 1895 and $23,571,248 in 1902. The earnings were then $2,232,051, while now they are $3,937,771.

The Requirements of Machine Tool Operation With Special Reference to the Motor Drive.*

BY CHARLES DAY.

IN opening the subject Mr. Day dwelt on the fact that machine tool operation by motor drive in any case involved not only intelligent analysis but also a broad view of the subject that the relative importance of the various factors be evident. It is easy to become so interested in a given detail—the motor drive as an example—that its true position in the general scheme is entirely lost sight of.

As example of such an analysis, Mr. Day considered a plant composed of foundry, machine shop and office, manufacturing complete machines from the crude material, and the chart of Fig. 1 was presented as enabling the relative data to be quickly grasped, the chart showing the distribution of cost of the finished product of the plant in question.

It would be easy to analyze still further the fixed charges, labor and material shown above. The former can be divided into insurance, depreciation, repairs, power, etc. Labor may be subdivided into productive and non-productive, and material into proportion of steel, cast iron, brass, etc. The more subtle factors, such as sanitary conditions and light, must also be constantly borne in mind. Of all these factors only the equipment and means which may be necessary to enable the workman to use it to its full capacity will be considered. We will start in the pattern shop or forge department, and see that

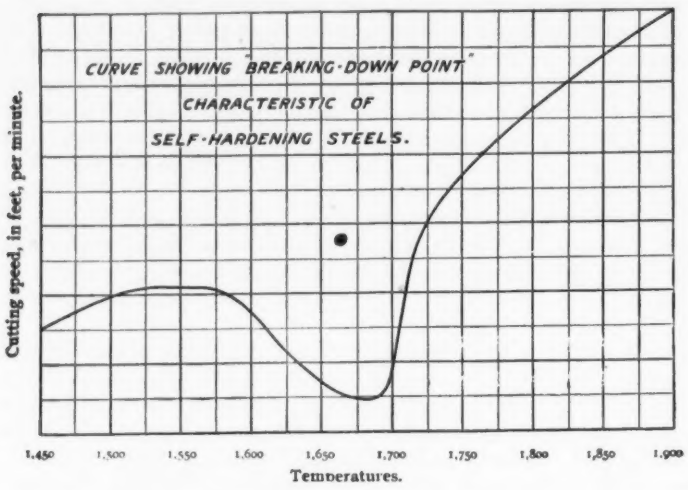


FIG. 1.—CURVE SHOWING PRINCIPLE OF TAYLOR-WHITE PROCESS OF TREATING TOOL STEEL.

everything is done to facilitate future handling and machining. A lug on a heavy casting to make it easy to catch hold with the crane, or in some cases additional metal to remove, to prevent the possibility of working too close to the chilled scale, will frequently effect more saving than is possible by other means.

The remarks that follow will relate to shops doing a general class of work, as it is much easier to arrive at a high standard where parts are duplicated in large numbers. In the latter case we can profit by experience, while in the former we must anticipate each move. In one instance machines are designed for a given duty, while in the second they must be adapted to a certain class of work, and as a result seldom handle any job to the best advantage.

Referring again to the example under consideration, we will suppose the castings have been received in the shop and the method of machining determined upon. A certain amount of metal has to be removed and a definite finish is required, our object being to accomplish this result in the least possible time, or, rather, at the least expense. Instead of taking any given example the course of reasoning will be outlined which must be applied before we can intelligently answer this question.

The tool steel is the keynote to the situation, and a complete knowledge of its characteristics and possibilities forms the starting point for all further work. Carbon steel will give a finer finish on steel than the air-hardening variety, and for form cutters is still largely used. Where heavy roughing cuts are possible, air-hardening steel has unquestionably replaced it; and, in fact, the recent developments in the processes of hardening have been the direct means of revolutionizing old methods of machine tool design and so-called shop practice.

We must ever bear in mind that "best shop practice" should mean "arriving at the desired result at the least cost," and can be used in a relative sense only. If drilling with a feed of 1-16 of an inch per revolution gives the desired finish in much less time, it is certainly good practice, and if under these conditions we find a sharp point on the drill is not essential, so much the better.

The influence of the Taylor-White process has been so revolutionary in character that it may be dwelt upon for a few moments. The underlying principle of this discovery is clearly shown on the accompanying curve, Fig. 2, which is plotted from values of cutting speeds and temperatures. It will be seen that this curve rises from the zero point until 1,550 degrees are reached, when the cutting values suddenly fall off. The most interesting and valuable fact that these

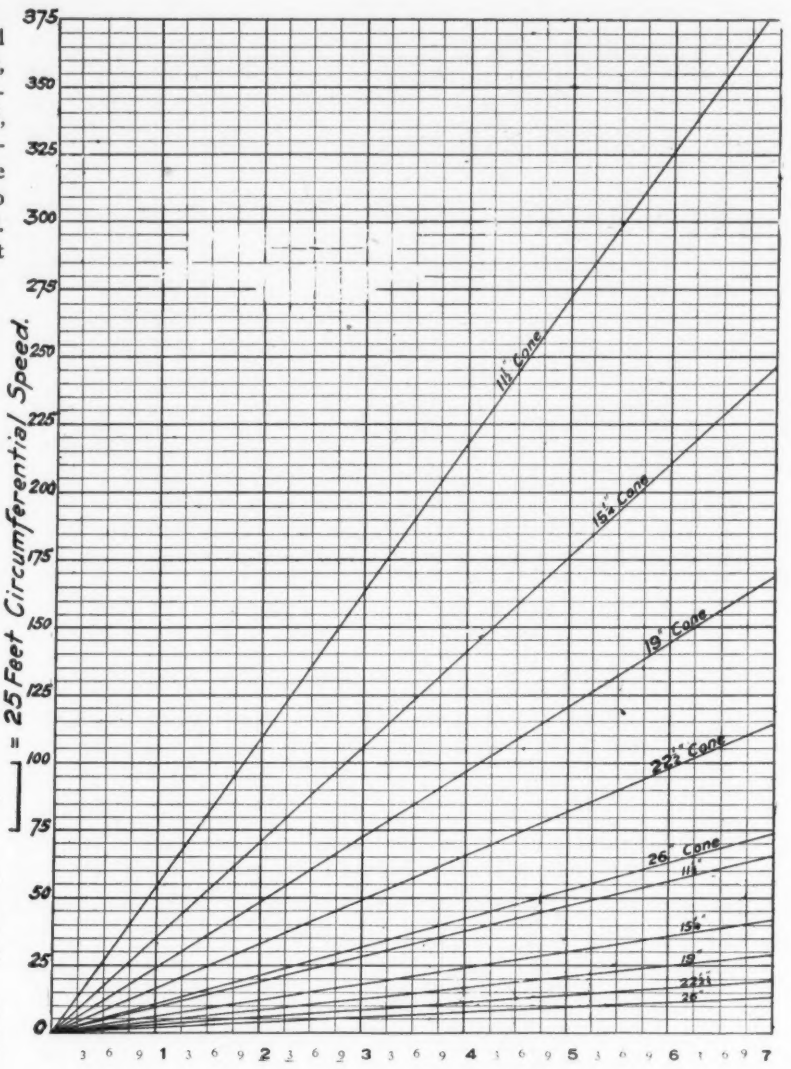


FIG. 2.—CHART USED FOR DETERMINING CUTTING SPEEDS.

values again increase if the hardening temperature is carried beyond the "breaking down point," was the result of work just referred to, which established the superiority of steel treated in this way over Sheffield Mushet.

An exact knowledge of the cutting speeds of which these tools will permit when machining different materials, and the power to pull various cuts under all conditions, are absolutely essential if we wish to properly design machine tools, or use them to their full capabilities in actual service. The value of this information is now being realized by several of the machine tool builders, and the results are already being felt in the shop in the form of much more efficient machine tools.

In driving machine tools the requirements to be met are the following: A machine having been designed for a given duty, its maximum and minimum speeds are limited by the character of the work it

* Abstract of a paper presented before the December meeting of the New York Electrical Society.

will do; the number of speeds is determined by the character of the metal machined, and the uniformity of the tool steel and the power required is fixed by the most severe conditions it must meet.

For the average machine tool we do not think present conditions demand a closer speed regulation than 10 per cent., as no good means has yet been reached for determining the character of the metal, and in the average shop little is understood about the relations existing between feed, speed and depth of cut for various materials.

There are two sides to the question, viz.: the refinement of speed required by the various elements with which we are dealing and the possibility of using this refinement to its full efficiency in actual practice. The first set of requirements may demand a speed regulation of 10 per cent., while the second would indicate that it is extremely difficult to use it to advantage in actual practice with present facilities.

For certain classes of work slide rules based upon the empirical formulæ referred to above seem to us to be the only solution to the problem. By means of these most ingenious rules it becomes possible to instruct the workmen how to do the work to insure maximum efficiency, the feeds, speeds and cuts all being dictated indirectly by the positions of the various handles and gears controlling these factors. These slide rules must be in the hands of a force of men who are perfectly conversant with machine shop work and able to lay out the course any particular piece should pursue in going through the shop. The cutting speed for steel is determined by the tensile strength and elongation, while for cast iron the problem is still more complex. The hardness is not only affected by the chemical composition, but the method of cooling and size of the casting, so that we seldom find two castings that will permit of machining at the same speed.

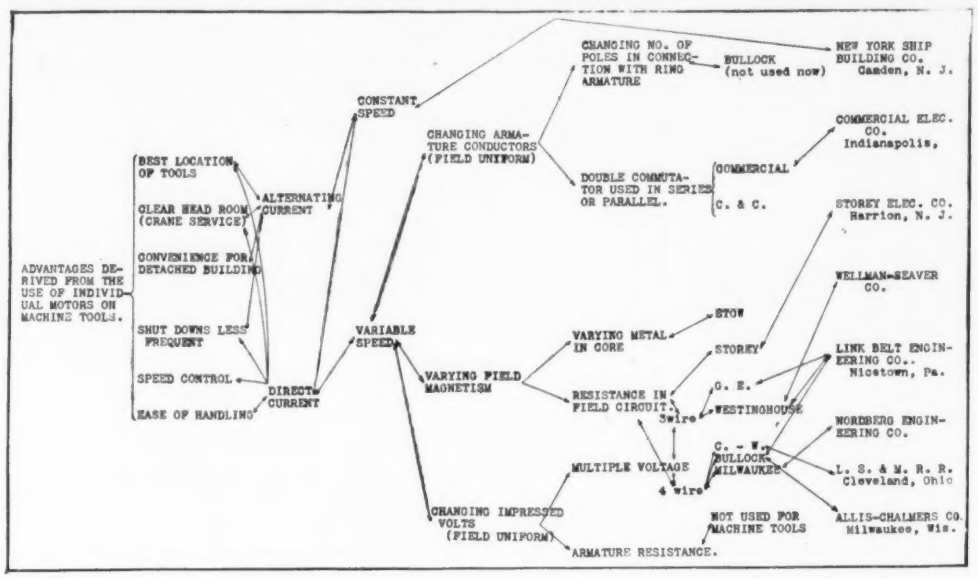


FIG. 3.—PRINCIPAL ADVANTAGES AND VARIOUS METHODS THAT MAY BE ADOPTED FOR DRIVING MACHINE TOOLS.

It is possible, however, by careful observation and experiment, to ascertain approximately for a given shop the cutting speeds of which various jobs will permit, so it is absolutely essential to have some good means of determining it. It is impossible to judge the speed by eye, even where a man works on the same tool continuously; nor will the character of the chip when cutting cast iron indicate the proper speed.

As a means of remedying this difficulty charts such as that of Fig. 2 enable the men to ascertain the cutting speed from a knowledge of the diameter of the work and location of belt and gears. Great difficulty is found, however, in making the men sufficiently familiar with these charts to use them to advantage. The antagonism when introducing new methods or machines, so often evidenced by the men, is largely eliminated when the innovation is so extremely simple that its use can be grasped by the men at once. A much better scheme than the charts is the use of tables designating the spindle speed for each point of the controller or position of the belt, as feeds are frequently enumerated on lathes, etc.

When slide rules are not used a "speed tally" on each machine would be the only proper way of enabling the workman to know the speed at all times. No skill is required in its use or time lost in making the reading. A tachometer suitable for this work would be a desirable addition.

The most characteristic and valuable features of the electrical

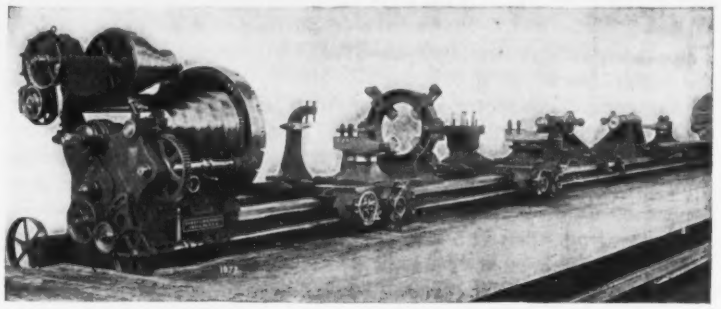


FIG. 4.—LATHE DRIVEN BY INDUCTION MOTOR.

systems are the elimination of complication and physical effort in handling the machines and the direct advantage resulting from this cause, may be very far-reaching. The inefficiency of the belt and step cones, as a means of machine tool driving, even when installed in such a way as to permit of good crane service, is too well understood to demand much consideration here. The motor is an equally poor investment if, after its introduction, the shop is run along the same old lines, and for this reason an understanding of its possibilities is most essential. This applies to the motor on individual tools, and, although the remarks are general in character, it is understood that its use is not advised on every machine.

The accompanying chart, Fig. 3, shows at a glance the different methods on the market for motor-driving machines. The constant-speed motor, particularly of the alternating type, is so simple in character we naturally turn to it as a possible solution to the problem. It lacks, however, the two great essentials, ease of handling and speed regulation, and all attempts to supply these shortcomings by mechanical means have so far proved unsatisfactory.

The induction motor is a source of power, just as the line shaft, and the principal advantages resulting from its use are clear overhead room, independent location and possibly a saving in power. These features are all embodied on the lathe shown in Fig. 4, but the inefficiency of the outfit from other causes makes this application out of the question. The motor is handled from the head stock, and as a result the ease of handling is far inferior to the

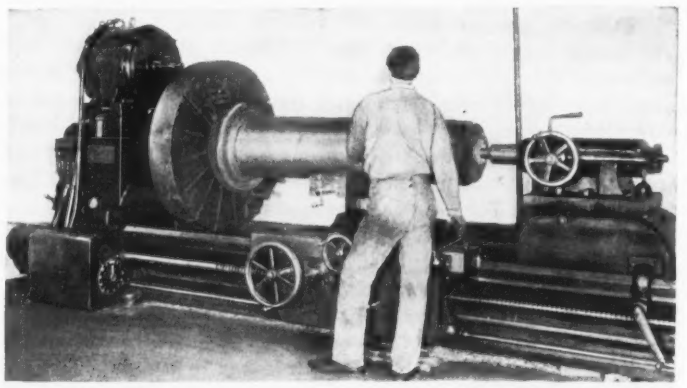


FIG. 5.—LATHE DRIVEN BY VARIABLE SPEED MOTOR (FOUR-WIRE SYSTEM).

old belt and shifting pole. The heavy double belt of such short centres must be tightened to such an extent that much time is lost in shifting, and in many instances it would not pay to do so.

When the operator is working at a distance from the head stock

on a job where the tool is liable to dig in and cause trouble, it becomes necessary to have a helper at the switch to shut down the motor upon signal from the machinist, the inefficiency of such an arrangement being self-evident. In comparison with this lathe another illustration (Fig. 5) is given, showing the operator varying the speed. The control is always under the hand of the machinist, 42 speeds ahead and six reverse being possible in a range of 6 to —. The controller is shown attached to the bed under the head stock, and the 4-pole fused switch of specially heavy design is bolted to the head casting. The motor is a standard type, and can be replaced on short notice in case of accident.

The variable-speed counter shaft would seem to be a natural solution, but Mr. Day says that, speaking generally, all such devices that depend upon power transmission through frictions, are unsatisfactory for general adoption in the shop, and in most cases the method of handling is not comparable with the multi-voltage systems. A variable-speed countershaft that is to meet with the success anticipated by some engineers must be handled from a master control, and in fact do everything that is possible with the highly perfected electrical systems that are now being installed.

As the ease of handling and close speed regulation cannot be efficiently obtained with the constant speed motor, attention will now be given to the variable-speed type.

Fig. 6 shows the schemes of voltages adopted by the principal manufacturers of multiple-voltage apparatus, one sketch showing a three-wire system and the other two four-wire systems, the voltages being arranged in geometrical and arithmetical progression respectively.

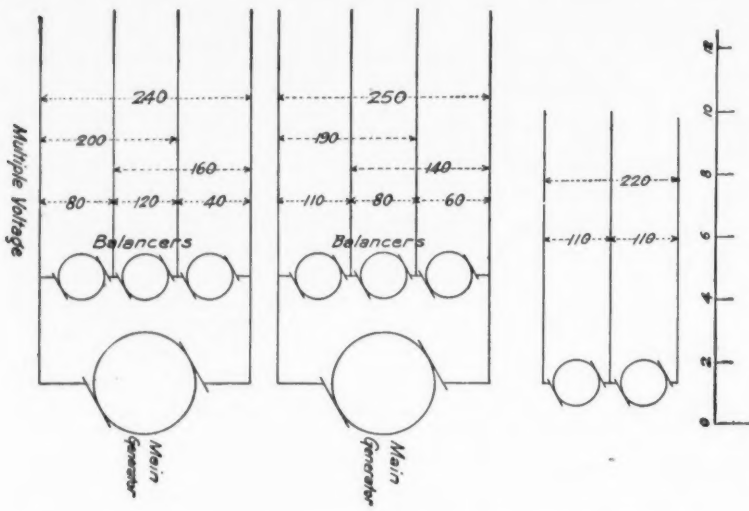


FIG. 6.—SCHEME OF VOLTAGES ADOPTED BY MANUFACTURERS OF THREE AND FOUR-WIRE SYSTEMS.

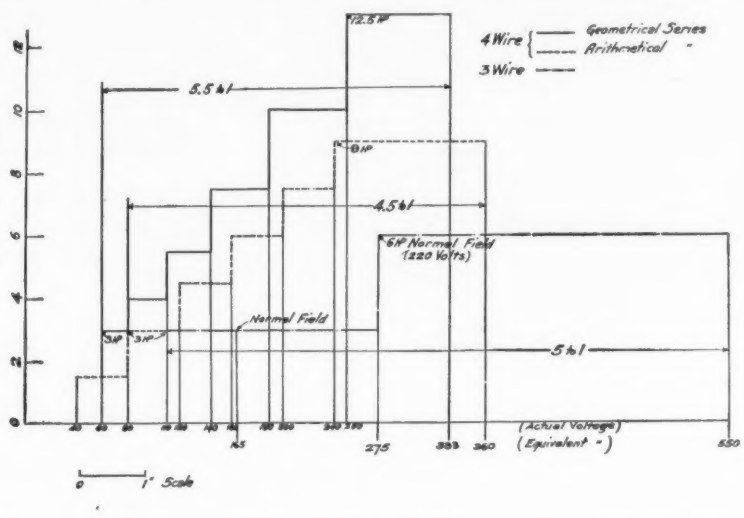


FIG. 7.—HORSE-POWER CURVES OF THREE AND FOUR-WIRE SYSTEMS.

In the first instance but two voltages are used, while in the latter cases, six are possible. Intermediate speeds are obtained by inserting resistance in the field, 100 per cent. variation being necessary in the three-wire systems, as compared with 30 per cent. in the four-wire. In either case the horse power that the motor can develop satisfactorily is directly proportional to the voltage.

A comparison of the underlying principles of these systems is clearly shown by the accompanying curves, Fig. 7. It is interesting to note the relative sizes of motors required to obtain a given range, but in this connection we must not form a hasty conclusion, as the cost for a given horse power depends upon the system adopted. That is, with the three-wire scheme there may be a variation in speed of 150 per cent. by field weakening alone, a special field winding being necessary. The satisfactory operation of these systems can only be ascertained after experience with the apparatus in the shop, so we can readily see how many considerations must be looked into before a final decision as to their relative merits can be reached. In a desirable system, standard motors should be utilized, the controller operated by a single handle, and the entire range of speeds passed over while the work continues.

The range of motor speeds is a most important factor, as the first cost of the motor, the cost of the installation and the efficiency of the outfit are all dependent upon it. It is impossible to lay down any fixed rules to base our discussion on, as each machine is a different problem, and must be treated as such. For general machine shop work we have found that a range of 4 to 1 to 6 to 1 adapts itself to all conditions fairly well, but in every case where old tools are being equipped we must be satisfied with a compromise.

We must study present conditions and in each case see how much they will be bettered by the use of a motor. Crane service alone may be ample reason for its adoption, or, again, where the intelligence of the men or facilities offered, make it possible to run each tool to its limit. We must ever remember that the belt drive, as applied to most machines, does not permit of running to the tool limit on the average job, while the motor, if properly installed, offers the opportunity. It can do nothing more.

If we cannot accurately figure beforehand what economy will result from the use of the motor, it may at least be of interest to investigate the records of shops who have made such installations. We must, however, be very careful not to draw too hasty conclusions as to the merits of the apparatus from such investigations, as the equipment is utterly useless without the management and organization behind it.

In the shops of the Link-Belt Engineering Company, an accurate record, extending over five years, gives the pound cost of machining, and the reduction in this figure during this period gives a more accurate gauge of the economy effected than any other method. These figures were compiled by a disinterested party, and after taking into account every detail which might in any way introduce an error, and allowing the men a decrease of 10 per cent. in time, with the same wages per week, a clear saving of 30 per cent. on the entire labor bill was shown.

The problem is such an involved one that it would be decidedly wrong to attribute this sum to any direct cause, it being the result of better management, equipment and understanding of its possibilities. It is needless to say that this saving is vastly in excess of the interest and depreciation of the entire expenditures necessary to bring about the result.

The successful engineer must ever keep foremost in his memory the utility of the apparatus he is designing, the importance of the management and organization, and the great value of anything which simplifies these underlying factors of all manufacturing establishments. To quote the convictions of one of the greatest managers, who said, in substance: If you swept from him trade, factories and finances, but left him his organization of captains, that minimum cost could be secured throughout every detail of mining, shipping, refining and manufacturing, so that instead of doing part excellently and some badly, in a few years his cost advantage would restore his trade, plant and facilities. So certain was he others would do both well and ill, not well throughout.

New German Cable Ship.

The new German cable steamship *Vulcan* was launched at Stettin, Germany, on December 30. The following dispatch was received by Max Guillaume, the chairman of the company, from the Kaiser on the occasion of the launching: "I hope the new German Atlantic cable will contribute to further strengthen the good relations between Germany and the United States."

A Year's Output of Bell Telephone Instruments.

It is stated from Boston that the net output of the American Telephone & Telegraph Company for the year ended December 20, 1902, was the largest in the history of the Bell telephone system and amounted to 624,714 instruments. The net output last year was larger than the total number of instruments outstanding in 1894. The rate of growth was, however, less than in two former years, 1901 and 1899, being 25 per cent. last year, against 29 per cent. in 1901 and 40 per cent. in 1899. We note also for the month of December a net decrease of 7,070 instruments in the output.

The company's record of total instruments outstanding for the past ten years ended December 20 follows:

	Total outstanding.	Increase.	% Increase.
1893	566,491	13,771	2.4
1894	582,506	16,015	2.8
1895	674,976	92,470	15.8
1896	772,627	97,651	14.4
1897	919,121	146,494	18.9
1898	1,124,846	205,725	22.3
1899	1,580,101	455,255	40.4
1900	1,952,412	372,311	23.5
1901	2,525,606	573,194	29.3
1902	3,150,320	624,714	24.7

In the five years ended December 20, 1897, the number of instruments outstanding increased 66 per cent. In the five years ended December 20, 1902, the number increased no less than 242 per cent. The remarkable growth in the last five years has been owing to the marvelous business activity of the country and the popular favor into which the telephone has recently come. The high-water mark of rapidity of growth was reached in 1899, although the net output of instruments was larger in the past year. The lower rate of increase in 1902 indicates possibly the effect of independent competition, and that the phenomenal growth of the past few years will be succeeded by a period of slower but still steady growth, as in 1892-97. The slowdown may, however, be offset by the cheapening of the cost of service, by which means the company hopes still further to extend the use of the telephone. In New York City, for example, the Bell system is growing at a tremendous rate.

Mr. Marconi and His Critics.

Note was made in the newspapers last week of the criticisms offered on Mr. Marconi's recent work and its commercial status; particularly the remarks of Sir W. H. Preece. In a public reply to these comments, Major Flood Page, of London, director of the Marconi Wireless Telegraph Company, of London, and of kindred interests, says: "Sir William is reported to have said that there was nothing conclusive given a year ago by Marconi to show that the signals across the Atlantic, made by the wireless system, were not due to atmospheric conditions. There was nothing conclusive about those signals, except the word of Marconi, which, though not good enough for Sir William, was sufficient for Mr. Edison, Prof. Bell, and Prof. Pupin. It should have been sufficient for Sir William Preece, who knows Mr. Marconi well, and who also knows that Mr. Marconi has never had to withdraw a single statement that he ever made to the public.

"As for Sir William's statement that the cable companies are not disturbed with reference to the wireless possibilities, I will say that only a short time ago in America, in talking with one of the best-known men in England, connected with the cables, this man said to me: 'Yes, you Marconi people are playing "Old Harry" with our cable companies, and have reduced the shares most appreciably. I will say, though, that when they fall a few points lower I shall put all the money I can scrape together into cable stock, as I believe it will be worth the reduced price to which they are rapidly falling.' This man is as well known to Sir William Preece as he is to me, and instead of being one of the 'old women' shareholders, to which Sir William refers, he is a competent electrician who has assisted and is still assisting the cable companies to the best of his abilities.

"As for the reliability of the Marconi messages, I will say that only a few days ago Mr. Marconi sent a long message to his Majesty King Victor Emmanuel of Italy. The message was entirely in Italian, was received at Poldhu by operators, none of whom were familiar with that language, and was delivered to the King, absolutely correct and without a mistake in it. On receipt of the message the King sent an answer signed by his own hand, which was received at Cape Breton by Marconi. What more conclusive proof of the reliability of the Marconi system could any one wish?

"Sir William also says that it is possible to tap every message. Supposing, for the sake of argument, that it is possible to tap every message; have not telegraphic codes been established, and as an officer in the British Navy told me not very long ago, it is quite possible, were it necessary, to change the code every day. Even if at present it is easy to tap the messages of the man of whom Sir William is so evidently jealous, there can be no doubt that the genius of Marconi, which has already overcome so many difficulties successfully, will be able to solve a problem which is not near so difficult as Sir William Preece asserts.

"It is true, of course, that the cables, with their fifty years' experience, can send a message more quickly than can the Marconi system, but they cannot send them more accurately. Mr. Marconi, in his recent address before the Royal Institute of England, said that with his magnetic detector he could transmit thirty words a minute. While this will not bear comparison with the speed attainable by the cables, it will nevertheless compare quite favorably with the speed of the cables fifty years ago, which I believe was about one word a minute. We are not foolish enough to imagine that we shall be able to compete for some time to come in either speed or in the amount of our business with the well-established and wealthy cable companies. We do believe, though, that there is room for us as well as them, and that we shall be able in a time, measured by months, to have in operation a successful Marconi wireless telegraphic service across the Atlantic Ocean."

Underground Electric Road for Boston.

The fact has not attracted general attention that the citizens of Boston have accepted the act formulated to provide for a new underground elecric railway system. This act requires that a contract for the use of the tunnel and subway should be made by and between the Boston Transit Commission and the Boston Elevated Railway Company. Such a contract was signed September 25, and many of its items are interesting. The term is twenty-five years from the beginning of the use of the tunnel, and the annual rental is to be 4½ per cent. of the net cost of the tunnel and subway respectively, including all expenditures incurred in acquisition and construction—damages, expenses, salaries of the commission, and interest at 3¼ per cent. per annum on the debt incurred in construction prior to the beginning of use. Such net cost shall also include amounts expended for preliminary investigations and for alterations in the existing subway and approaches thereto necessary to readapt it to the use of surface cars. Deductions shall be made from the cost for the proceeds from sales of property and for a fair valuation of lands and structures no longer needed for the purposes of transportation.

The act empowers the Boston Transit Commission, which has had charge of the construction of the earlier subways and the East Boston tunnel, to build a system of tunnels and subways so designed as to be adapted for the accommodation of two tracks especially for use by elevated cars or trains and two tracks for surface cars, with the necessary approaches, stations and other appurtenances, including connections with the East Boston tunnel and the existing subway. The new tunnel and the new subway may be built entirely separate or may be connected, as may be decided by the commission to be most economical and convenient for traffic. The exact locations have not been determined but are limited to a territory averaging about 1,200 feet in width easterly from the existing subway, excepting that north of Scollay Square the zone of location extends to the westward of the existing subway a similar distance, as well as to the eastward.

The act requires that the construction of the tunnel shall be begun immediately and of the subway at such time after the expiration of one year from the completion of the tunnel as the Commission and the Boston Elevated Railway Company may agree upon, but it is intended to push the construction of the subway also.

Borings have been made to determine the character of the subsoil under Washington Arch and other streets where the sub-

way may run, and a field party has been put at work to survey and test the foundations of the buildings in the district which may be affected by the construction of the new subway and tunnel. Each of these new underground thoroughfares will have double tracks, and it is reported as cheap to build them separately as to construct a double-deck subway. The matter of cost will, however, be subordinated to public convenience. Contracts will probably be let as soon as the preliminary work is finished, and construction work actively pushed in the early spring of 1903. Although the commission has an additional year in which to begin the construction of the subway for surface cars, it will probably be started at about the same time as that for elevated trains.

Upon the completion of the new subway there will be three underground rapid transit trunk lines traversing Boston's business district from north to south.

New Telephone Patents.

Of the patents of the issue of December 23 of interest to the telephone field two did not come to hand until too late for consideration in connection with the other telephone patents of that issue. These cover respectively a new type of sneak current protector and an improvement in cable hangers.

The new protector is the invention of E. A. Stevens and consists of a thermal or heat coil wound upon a metallic spool, to the upper surface of which there is attached by a suitable low fusing alloy a metallic spring. The circuit to be protected is carried through the heat coil, soldered connection and spring in the ordinary manner. When an excessive current flows and the alloy is melted, the spring flies away from the spool, thereby opening the circuit. The chief merit in the invention is its adaptability to almost any of the present designs of fuse holders, as is well shown in Fig. 1, which shows two of the many styles of mounting.

The improved cable hanger or cable clip is of the flexible zinc band type, various modifications of which type have followed each other

FIG. 1.—STEVENS CIRCUIT-BREAKER.

in rapid succession of late. This latest design is the invention of Frederic P. Auxer, of Cleveland, O., and resembles in general appearance the well-known "Boston Cable Clip." The hook and link, however, are herein so designed that they form a tightening and locking device so that when the hanger is once in position the zinc band fits the cable very snugly, being locked so that it cannot loosen. The object of this is to overcome the unruly tendency that clips of this general type show to becoming displaced along the cable and gradually working into groups.

Coming now to the Patent Office issue of December 30, there are found six telephone patents, of which the Kellogg Switchboard & Supply Company, of Chicago, are the assignees of no less than four. These embrace two special designs of telephone receiver, both the inventions of Mr. K. B. Miller, and a new distributing board protector and its spring holder. These latter are the inventions respectively of William A. Taylor and William Kaisling. For convenience the two receivers will be considered together and as will also the two arrester parts.

Fig. 2 shows sectional views of both of Mr. Miller's receivers. In the receiver shown in the upper part of the figure a heavy diaphragm, perforated at its center, is formed across the rear end of the containing shell, and upon this diaphragm the terminal lugs of the receiver are mounted, the terminal wires of the receiver coils, heavily insulated, being carried out to them through the central aperture. Beyond the diaphragm a rounded cap, removably fastened to the receiver shell through the agency of screw threads, is arranged. This cap also has a central aperture, but in this case to admit the receiver cord. By this arrangement and design of the parts, there are no exposed metallic connections to give a shock to the telephone user or to be readily disturbed by him. Another special feature of this receiver is the enlargement of the receiver cord, plainly shown inside the cap, which enlargement serves to transmit all undue stress to the body of the cord, rather than to the electrical connections.

Almost the only claimed difference between this and the second receiver is that in the latter, instead of the terminal diaphragm being a portion of the receiver shell it is mounted integrally with the receiver magnets, the supporting cord fastening being now transferred to this diaphragm. The specified result of this is that in case of undue

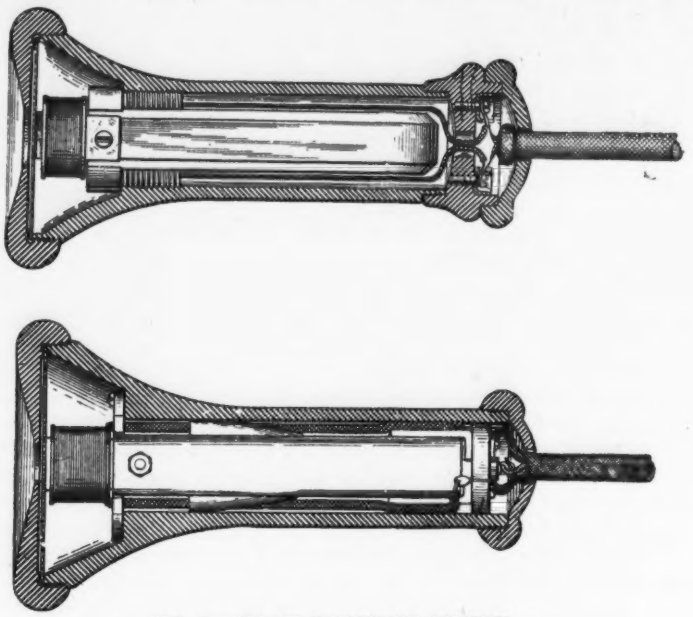


FIG. 2.—MILLER TELEPHONE RECEIVER.

strain coming upon the receiver cord, such as when the receiver is dropped and the fall is stopped by the receiver cord, there is no tendency to break the hard rubber shell, all parts of it being removed from the line of stress.

The new distributing frame protector is well shown in Fig. 3, in which we have a plan view of an arrester bar and a sectional view of one of Mr. Taylor's thermal devices. In this latter device, instead of the coil of fine wire customary for such apparatus, there is provided a small cylinder of graphite or some similar refractory substance of high specific resistance. Both ends of this cylinder are copper-plated, and upon each is soldered by means of fusible alloy a small metallic cap. These metallic caps are adapted to engage the arrester springs, b^1 and c^2, as shown, these springs forming part of a group of eight springs, sufficient for one pair of complete protectors. Of these eight springs the two marked *a* are connected to the switchboard, while those marked *b c* are connected to the cable or outside wires. The springs *a* and *b* assume normally the position shown on the upper side of the arrester strip, but when the thermal device is inserted, they are pulled into the position shown below the strip. Thus the insertion of a thermal device puts this latter under a tensional

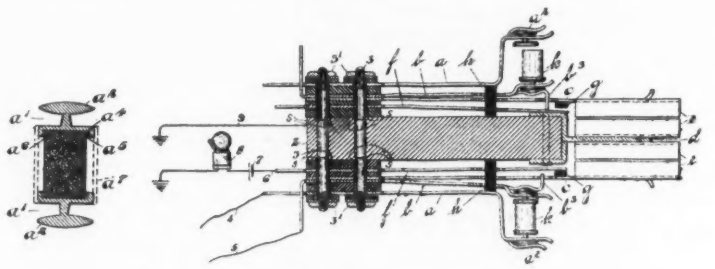


FIG. 3.—KAISLING PROTECTIVE APPARATUS.

stress and holds the point b^3 of the spring *b* away from the ground plate and the spring *h*. Now when an excessive current passes toward the switchboard, the graphite cylinder becomes heated, due to its high resistance, with the result that the fusible alloy melts and one of the caps is pulled from the cylinder. This opens the circuit toward the switchboard and grounds the wire from the outside, so that the excessive current may do no further damage. It also incidentally grounds the spring *h* and thereby operates an alarm to give notice of the open subscriber's line. Of course, the regular carbon block open space cutout is also provided for these protectors, *c c* being carbons, with the usual mica separator indicated between them. A very good feature of this device is the series of two con-

tacts held together by fusible alloy, one of these at each end of the graphite. In case one contact sticks in any manner the other is in a position to operate. By this means the liability of a failure is materially reduced.

A fifth telephone patent of the issue under consideration is that granted to T. C. Knowles, and relates to the provision of a pivoted receiver arm for telephone sets, so arranged that while normally it hangs down in an out-of-the-way position, it may be raised to a nearly horizontal position, when it will hold the receiver in such relation to the transmitter that the telephone user must come close to the transmitter mouthpiece. The receiver arm is arranged in addition to control the hook switch mechanism, and as it is locked in position by a spring after using the instrument, one must remember to release the receiver. The device is really just the equivalent of the so-called hand microphone, except that it is self supporting and that the receiver is much more likely to be, so to speak, "left off the hook."

"Automatic Electric Exchange System" is the title under which Mr. W. R. Binkley patents certain improvements to the Strowger or similar automatic systems, whereby selective ringing party lines may be connected to such an exchange. The key to this invention lies in the fact that instead of special station designations, con-

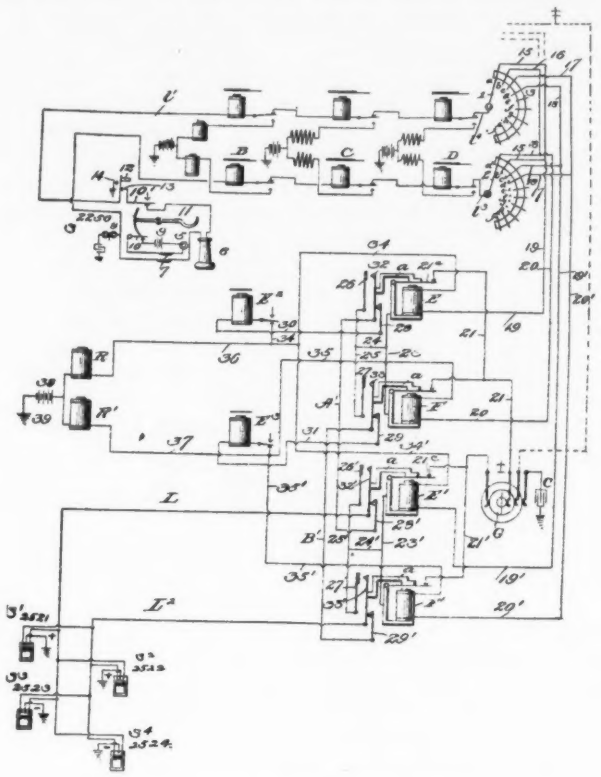


FIG. 4.—BINKLEY EXCHANGE SYSTEM.

secutive numbers are assigned to the various stations of the party lines. For example, the stations of two party lines would be designated by numbers, such as 1,255 and 1,256, or 6,820 and 6,821. Similarly, for four party lines, four numbers would be assigned, thus, 1,255, 1,256, 1,257 and 1,258, or 6,820, 6,821, 6,823 and 6,824. This method of designating is made use of by carrying the conductors of the line through points, first in one bank of contacts and then in the other, instead of as at present, where one bank of contacts is used exclusively for one side of the line. This may be better understood by reference to Fig. 4, wherein 1 and 2 are the two banks of contacts of a line selector, and *a b c d a' d'*, etc., are the contacts of a four-party line with stations S^1, S^4. Contacts *a* and *b* are connected in each case to the opposite side of the line from *c* and *d* of the same bank of contacts. Now if station *S*, shown in the upper part of the figure, has operated his selectors in a manner to leave the wipers *1* and *2* upon the contacts *a* and *a*, and if he then pushes his key, *12*, to signal, current will flow from the grounded battery *38* through the upper retardation coil *R* and thence through a readily traceable circuit involving the coil of the relay *E* through the line selector and the various preliminary selectors *B C D* to the ground *14*. This causes relay *E* to operate, performing thereby the usual functions of a ringing key and connecting the terminal marked + to the line wire L^1.

This is designed by the inventor to ring the station S^1 only, but as the circuits are arranged by him it will ring both S^1 and S^2, for he has inserted a condenser *c* at the ringing generator ground, completely losing sight of the fact that a discontinuous pulsating current becomes alternating upon passing through a condenser. The principle of the invention is not, however, affected. If the wipers had been advanced to *b b'*, and we will suppose the bell at S^1 only responded, relay *F* would have been brought into position to ring S^2, etc.

It is not quite apparent from the circuit drawing, but as a matter of fact the relays *E*, E^1, *F*, F^1, are so disposed in the circuits that they produce no effect upon the normal selective actions of the system. They do, however, introduce a decidedly objectionable feature in that for all calls toward a party line the windings of two of them are in the talking circuit.

CURRENT NEWS AND NOTES.

KING EDWARD'S TRAIN.—The new royal saloon train for King Edward and Queen Alexandria not only has electric lights in fixtures, electric fans and electric heating and cooking apparatus, it is said, but portable electric lamps adjustable to plugs and electric cigar lighters. All it now needs is electric propulsion.

ELEVATORS IN ITALY.—U. S. Consul R. Pearson, writing from Genoa, says: "American elevators, if once introduced here and elsewhere on the Continent, would quickly and surely supplant the cumbrous, uncertain and inefficient, machines turned out by the factories in Milan and in various parts of France. The houses in this city average seven stories in height. Elevators are greatly needed; the few that are installed were purchased in Milan, and the contrivances are almost comically defective. They take passengers upstairs at a snail's pace and cannot bring them down at all."

CRITICISM ON TROLLEY CARS.—In a letter addressed to the Merchants' Association of New York Dr. George A. Soper, sanitary expert, speaking of the modern electric car of the type used in New York says: "It seems to have been built with the idea that the public would not crowd at all or would be willing to crowd like cattle. The small proportion of space devoted to seats as compared to that devoted to standing room, the broad platform, the central location of the electric lights, and the want of an adequate ventilating system, are all evidences that the cars are not well adapted to carrying the number of people who ride upon them." All of which sounds true, but the great trouble is to remedy the general conditions that necessitated the creation of such cars.

POETRY IN LIGHT.—Discussing stage effects, Mr. David Belasco, the famous playwright, says: "All the miracles that electricity has wrought, all that it may yet achieve, will be seized upon by the dramatist. Let him have only soul and imagination; electrical science will step in and paint his pictures for him. Sunsets, drifting clouds, sandstorms, flowing rivers—these, and more, have been reproduced to the life. If so much can be done with electricity in its comparatively undeveloped state, who shall say to what ends this marvelous force may not be carried in its uses on the stage? Painted scenery, as we know it to-day, may become a thing of the past. The whole stage picture may be a light picture, and the scenic artist may yet be required to do with lights all that to-day he does with brushes and paints."

PRANDIAL ELECTRIC REPTILES.—As though modern nerves had not already enough to jar them, it is stated that a woman with a mania for the curious is planning a "reptile" dinner with which to dazzle her guests. In the center of the table she has planned to have a miniature lake on which will float water lilies and their pretty green pads. About the lake and scattered all over the table will be a profusion of sinuous reptiles, with an occasional frog and brilliant beetle to enhance the effect. These odd creatures will be gorgeous in hue and big as to eye, for it is in the grotesque bulging eyes that the electric lights will be placed to glisten upon all beholders. In the bodies of the snakes other lights will be concealed to illumine their whole scaly lengths. Combinations of colored lights and seemingly live crawling things will produce a startling effect. It has been suggested that the snakes and things may be too realistic to please her masculine guests. For them it will be literally a case of "seeing things at night."

NORTHWESTERN ELECTRICAL ASSOCIATION. — The regular winter convention of the Northwestern Electrical Association will be held in Milwaukee, beginning Wednesday, January 21, 1903. Secretary Thomas R. Mercein, 85 Michigan Street, Milwaukee, announces that an interesting programme is in preparation, but that all the details have not been completed as yet.

BUILDING A ROAD BY NIGHT.—The plan of building a railroad by electric light is a novelty that will be introduced by the Santa Fe Company when it begins construction of its cut-off to connect its Pecos Valley line with its main line in New Mexico, within two months. Six hundred men will be put to work in Abo Pass canyon and a large electric light plant will be installed at its mouth, so that men can work at night as well as day.

ELECTRICAL INSTALLATION AT INDIAN DURBAR.—On several occasions, in describing the preparations for the great Indian Durbar, recently held at Delhi, the correspondent of the New York *Sun* has made special reference of the electrical features. In a recent dispatch he pointed out that the electrical installation was the largest ever known, for a temporary affair. The overhead wires weighed some 60 tons and there were 50 miles of underground cable.

"THE DAILY MIDOCEAN" may be the name of a daily newspaper soon to be issued on one of the Cunarders, giving daily news of all kinds received by Marconi system. It is said that the Cunard offices here have been besieged by editorial candidates. A somewhat similar scheme was unfolded in these columns a few months ago, as to anchoring a steamer off the Scilly Islands, to send and receive news, telegrams, etc., with other passing steamers, by Marconi messages.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—Miss Harriet Billings, assistant secretary of the Association, writes us: "I take great pleasure in advising you that this Association begins the New Year with a total active membership of 445, an increase of 264 since the Cincinnati meeting. I feel sure that a great deal of this growth is due to the kind manner in which the Association has been supported by the electrical press and I wish to thank you for courtesies extended during the year."

NERNST LAMP GLOWER.—A defect of a solid Nernst lamp glower is its tendency to break down under currents of considerable volume, by reason of the central portion of the glower becoming fused by the current. In a patent issued December 30 to Henry Noel Potter, a glower is described which is designed to obviate this defect. The glower is in the form of a hollow tube, with the terminal wires twisted about the ends and covered with a pasty material similar in composition to that of the glower proper.

DIGEST OF TELEPHONE PATENTS.—A digest of all United States telephone patents issued to December, 1901, compiled by Mr. Jas. T. Allen, will soon be published. The work will be issued in three volumes and comprise several thousand pages of drawings, briefs and letter press. It will also include all of the reissues, designs and trade-marks granted during the same period, as well as a complete list of all the references cited, and the interferences and decisions incident to the course of the applications through the Patent Office.

TELEPHONY IN PARIS has always been pretty bad. A league of telephone subscribers has been formed in Paris, under the presidency of M. Tissot, the distinguished French chemist, for the purpose of forcing the Ministers of Posts and Telegraphs to improve the service. Several lawyers and barristers have joined the league, their intention being to enter an action against the Government whenever the neglect is flagrant or causes grave damage. M. Bérard has already promised to increase the number of female telephonists, and to make other beneficial reforms.

AUTOMOBILISTS IN FRANCE.—Mme. Reville, who recently received a prison sentence in France for fast automobiling and lost on her appeal to a higher court, has appealed to the President of the Republic for pardon. M. Ballif, president of the Touring Club de France, has made a protest to the Minister of the Interior against the undignified treatment of chauffeurs sent to prison for various alleged crimes. The Minister has ordered that the practices objected to be discontinued. His action is noted with sympathetic interest by automobilists in America.

PORTRAIT OF AMPERE.—A. Hermann, 6 Rue de la Sorbonne, Paris, has published at six francs a portrait of Ampere, printed on heavy Holland paper, 13 x 16 inches. The engraving is reproduced from an original which portrays faithfully the homely but strong features of the great savant, in this respect differing widely from the usual portrait found in print. We can vouch for the authenticity of this portrait, having some years ago received a copy of the same original from a Member of the Académie des Sciences, who had submitted it to several friends of Ampere still living, and by them it was pronounced an excellent likeness.

METRIC SYSTEM IN FRANCE.—A special cable dispatch from Paris says: The action of the American Chamber of Commerce in Paris in recommending the adoption of the metric system has led to an agitation among the Anglo-Saxon business men in favor of the change. It is believed here that England is only waiting on the United States Government to signify an intention of adopting the metric system to join in the movement. The only opposition encountered is among those engineers or manufacturers whose establishments are run on conservative principles and whom the introducing of the metric system would compel to overhaul their measures and machines, entailing considerable labor and expense.

COMPOUNDING ALTERNATORS.—Two patents issued December 30 to E. W. Rice, Jr., describe an interesting method for compounding alternators, based upon the employment at the generating station of a circuit which reproduces there the conditions existing at the receiving end of the line, as in the case of the Mershon indicating system. In the main line are two transformers, the primary of one being shunted by an inductance and resistance in series having the same relation to each other as the inductances and resistances in the transmission line; if capacity is to be compensated for a condenser would also be included in this circuit. The secondaries of the two transformers are in series and the resultant voltage, which corresponds to that at the receiving end of the line, may be impressed on a rotary converter, when the direct current side will supply a current to an auxiliary winding on the field of the generator; or the current from the miniature circuit may be rectified and fed direct to the auxiliary winding. The latter winding is connected in opposition to the main winding and its effect will be to decrease the field strength when the e.m.f. at the receiving end of the line rises, and vice versa.

ELECTRICITY IN SIAM.—U. S. Consul Hamilton King, of Bangkok, Siam, reports to the State Department that the electrical development of the city of Bangkok during the last ten years has been wonderful. The Siam Electricity Company, Limited, has a capital of £150,000 ($729,975), plus 200,000 ticals ($100,000 Mexican, or $46,000 in United States currency). It has 17,000 lamps of 16-cp, a tramway track of eleven miles in operation, and 40 cars in use, and others under construction; it is supplying electric power for various industries throughout the city, and is considering a line of automobiles to be run in connection with its tram line. The manager is now in America on business for his company. A request for another concession on the other side of the river is being pushed, and there are 26 private plants in the various mills, forts and dock companies, and in the navy yard of the city. The United States controls the market in this line now, and, with intelligent management, this trade could be greatly increased. The imports of electrical material direct from the United States in the year ending June 30, 1902, was $28,403, in a total of $52,949, but a large part of imports credited to other countries came from the United States. Consul King states there is a crying need for a large American business house in Siam. At present there is not in the whole of the country one American house competent to consider a Government contract, to push American trade, or to represent American interests.

LETTER TO THE EDITORS.

Mean Spherical Candle Power.

To the Editors of Electrical World and Engineer:

Sirs.—Referring to the report of the "Pittsburgh Local Section of the American Institute of Electrical Engineers," in your issue of November 22, it would appear that my position with reference to

criticism on the mean spherical candle-power method of comparing illuminants has been somewhat misunderstood. It has not been my intention either to abandon the present standard candle power or the use of the photometer, but rather to advocate a new *derived* unit—the effective candle power—a unit which is just as much based on the present standard candle power as is the mean spherical candle-power method of comparing illuminants. For example, to obtain the effective illuminating power of a given illuminant or set of illuminants by means of the two-room proposition described in my paper, it was proposed that the standard room be lighted with standard 16-cp incandescent lamps, and by this statement it was intended to convey the idea that these incandescent lamps should previously have been standardized on the photometer bar in the usual way by comparing with the standard unit candle. In this manner it was my desire to transpose the present standard candle-power unit into terms of effective candle power, and thereby establish not a new unit but a derived and more convenient unit for commercial purposes.

PITTSBURG, PA. A. J. WURTS.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compensating the Phase Difference in Induction Motors.—OSNOS; BRESLAUER.—Two communications referring to the articles abstracted in the Digest November 8 and November 29. Osnos replies to some critical remarks of Bragstadt and La Cour, and states that his arrangements are to be used by the Union Electric Company; experiments with one of his motors and with a Heyland motor showed that there was very little sparking in either case. Breslauer claims that in Osnos's as well as Bragstadt's and La Cour's arrangements it is essentially impossible to avoid sparking at the commutator, and he believes that the Heyland motor is far superior in this respect.—*Elek. Zeit.*, November 27.

REFERENCES.

Operation of Alternators in Parallel.—BENISCHKE; ROSENBERG.—Two communications in which they continue their controversial discussion concerning some special features in the causes of surging.—*Elek. Zeit.*, October 23, November 20.

Commutation.—ARNOLD; FREUND; ROTHERT.—Three communications referring to Rothert's article on the theory of commutation, recently noticed in the Digest. Arnold claims that some suppositions, made by Rothert, do not agree with the facts. Rothert in his reply does not deny this, but believes that his theory is an approximate representation of the facts.—*Elek. Zeit.*, October 30, November 13, 20.

Operation of Alternators in Parallel.—GOERGES.—A theoretical article in which he gives some critical notes on the theories of Rosenberg and Benischke.—*Elek. Zeit.*, December 4.

LIGHTS AND LIGHTING.

Osmium Lamp.—H.—An anonymous (apparently editorial) article giving the results of some tests of osmium lamps. The form of the globe of the osmium lamp is the same as that of the ordinary carbon incandescent lamp, while the light is whiter, but not as white as that of the Nernst lamp. The osmium lamp is always to be hung up perpendicularly, so as to point downward, and some caution is required in the use of the lamp, but not as much as with the Nernst lamp. Nine osmium lamps of 37 volts and 25 cp were used in the test, three in series at 110 volts. The tests took place for 300 hours, but the lamps were still in good condition after this time; the company states the life to be 500 hours. During the tests the lamps were burning for ten hours, and then disconnected for one hour, and so on. The different lamps gave about the same results; in one of them the candle-power decreased from 23 to 17.5, the current consumption in watts per candle increased from 1.53 to 1.97, while the average value of all tests for the 300 hours is 1.65 watts per candle. A comparative table is then given of the behavior of the ordinary carbon filament incandescent lamp, the Nernst lamp and the osmium lamp. The watts per candle are 3.20, 2.05 and 1.65 respectively. The first cost is 9, 50, 125 cents respectively; if the price per kw-hour is 16 cents, the average total cost of a candle-hour is 0.0005, 0.00035 and 0.00045 cents respectively. This shows that the osmium lamp is economically superior to the ordinary carbon filament incandescent lamp, while it is still inferior to the Nernst lamp; but concerning the latter point it is said that the Nernst lamp must be handled with greater care than the osmium lamp.—*Elek. Anz.*, December 18.

POWER.

REFERENCES.

Indian Power Plant.—A long illustrated description of the Cauvery Falls power plant in India, which will furnish power to the mines of the Kolar gold fields, as was noticed before in the Digest.—*Eng. & Mining Jour.*, December 27.

Elevators.—An illustrated article on elevators without shaft, but with counterpoise and electric windlass; elevators with shaft, and with compensators actuated electrically; and hydro-electric elevators.—*Sc. Am. Sup.*, December 27.

Electric Power in Iron Plants.—PERKINS.—An illustrated description of electrically operated charging machines, hoists, hauling and conveying apparatus in iron and steel plants.—*Sc. Am. Sup.*, December 20.

TRACTION.

Electrolysis of Gas and Waterpipes.—A note based on the report of a German gas journal stating that the committee appointed by the German Association of Gas and Water Engineers to inquire into the question of electrolysis of gas and water pipes, has failed to bring about any definite result. It had been hoped that, with the co-operation of the Verband Deutcher Elektrotechniker, some protective measures would have been drawn up and adopted; but when the suggestion made by the representatives of the gas industries were submitted, the electrical engineers would not accept them, and the deliberations have thus far not been productive of any beneficial results. The gas committee has, therefore, come to the conclusion that it will work independently of the electrical committee, at any rate for the present, and in the meantime will make inquiries of various gas and water authorities in large towns as to the extent of the damage which has been done by stray electric currents. They then propose to carry out experiments based on the information received, which they hope will guide them in drawing up certain rules for protection.—*Lond. Elec.*, December 19.

REFERENCE.

Electrolysis from Stray Currents.—MOERK.—A long communication in which he repeats his former proposal to prevent the dangerous results of electrolysis due to stray return currents from tramway systems, by reversing the direction of the current of the trolley system at periodical time intervals. He gives diagrams and describes arrangements by which this can be done easily and without danger.—*Elek. Zeit.*, December 4.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Central Station Statistics of Germany.—The annual very complete statistical tables showing the development and conditions of the central stations of Germany to April 1, 1902. Isolated plants and pure tramway plants are excluded. The information concerning the capital invested in the plants is incomplete, as only 475 of the total 870 have sent in reports on this subject; these 475 plants with an aggregate machine capacity of 197,061 kw, have cost about $77,800,000, i. e., about $395 per kw; in last year's statistics this average cost has $407 per kw; if a mean of $401 is assumed, the capital invested in the total plants of 358,000 kw aggregate capacity, is about $143,000,000. Sixty-six new plants have been opened, and the total number of central stations on April 1, 1902, was 870. Of these 709 are direct-current stations, 684 (or nearly all) being provided with storage batteries, their machine capacity being 150,500 kw and the combined machine and storage battery capacity being 208,800 kw. Twenty-five direct-current stations, with a machine capacity of 6,200 kw, have no storage batteries. Single and two-phase alternating-current systems are used in 45 stations of 30,500 kw capacity.

Three-phase currents are in use in 52 stations of 76,000 kw capacity. Combined three-phase and direct-current systems are in use in 50 stations of 87,000 kw-machine capacity and 107,000 kw combined-machine and storage-battery capacity. Combined single-phase and direct-current systems are in use in 12 stations of 7,500 kw-machine capacity and 8,000 kw combined-machine and storage-battery capacity. The total capacity of the storage batteries installed in direct-current stations is 27 per cent. of the total capacity of the direct-current stations; 58.6 per cent. of all stations use steam power and the machine capacity of these stations is 79 per cent. of the total machine capacity of all stations; 6 per cent. of the total number of plants (with a capacity of 1⅓ per cent. of the total capacity) use gas engines. The number of water power plants is 9.65 per cent. of the total number, the capacity being 6.75 per cent. of the total capacity; 353 stations have a capacity below 100 kw; 360 have a capacity between 101 and 500 kw, 66 to 1,000 kw, 33 to 2,000 kw, 30 to 5,000 kw; 17 more than 5,000 kw. The largest station is Berlin, Moabit, 9,000 kw, and with sub-stations 26,612 kw; the next one Berlin, Oberspree, 13,000 kw, and with sub-stations 25,425 kw; the next one Rheinfelden, 12,360 kw. All these are combined three-phase and direct-current systems. The next station in size is Berlin, Spandauer St., 10,785 kw, using direct current. The total capacity of the 47 plants which have a capacity above 2,000 kw, is one quarter more than all the other 833 stations together. At consumers' terminals these were connected with 50-watt incandescent lamps, an equivalent of 796,298 lamps (against 779,312 in 1901), of 10-amp arc lamps 20,613 (against 14,208 in 1901), and of motors 50,645 hp (against 35,645 hp in 1901). The enormous increase in the use of motors is due to their increased application in small shops in cities and partly also in agricultural districts.—*Elek. Zeit.*, December 18.

WIRES, WIRING AND CONDUITS.

Calculation of Networks.—MONATH.—An illustrated discussion of a new method of calculating the current distribution in networks, based upon Kennelly's theory of the equivalence of triangles and three-pointed stars in conducting networks (ELECTRICAL WORLD & ENGINEER, v. 34, p. 413, 1899) and later developed more in detail by Herzog and Feldmann. The method is explained and then illustrated by special curves. The author thinks that this method is well suited for the calculation of networks containing comparatively many branching points, and very few feeding points. But in other cases he thinks that the Coldri-Seydel method is preferable on account of its brevity and because it is systematic.—*Zeit. f. Elek.*, November 2, 9, 16.

REFERENCES.

Fuses.—HUNDHAUSEN.—A very long communication, illustrated by many diagrams, on the best construction of fuses.—*Elek. Zeit.*, December 4.

Wiring.—An article, illustrated by dynamos, on several problems in wiring.—*Lond. Elec. Times*, December 11.

ELECTRO-PHYSICS AND MAGNETISM.

Electrical Discharge from Hot Carbon.—CHILD.—An account of the results obtained in his continued researches on this subject. When a carbon pencil is heated, the positive discharge occurs first; this is true whether the carbon is heated in air at normal pressures, in a vacuum, or in hydrogen; if in air, it requires only a slight increase in temperature to produce the negative discharge; at higher temperature the negative discharge is the greater; both positive and negative pass through maxima as the temperature is raised. Within an enclosed tube the discharge is very much smaller than in open air. In a vacuum the negative discharge becomes many times greater than the positive at higher temperatures; the rates of discharge do not here pass through maxima. In hydrogen at higher temperatures the positive and negative discharges have nearly the same value; the discharge is here much higher than in air; both discharges pass through maxima. In general, the discharge from hot carbon behaves in a similar way to that from hot platinum; the velocity of the ions is diminished because of the presence of particles driven off from the carbon. The smaller velocity of the negative ions in the electric arc is quite probably due to the loading of the negative ions with these particles.—*Phys. Rev.*, December.

Ionization of Salt Vapor.—MOREAU.—An account of some experiments made to elucidate the mechanism of flame conduction. He introduced two small platinum condensers into a flame, gave a high charge to the lower one, and observed the conduction across to the upper one. He found that this conduction was independent of the charge of the lower one, and hence concludes that the flame contains no free ions, since these would be absorbed by the lower condenser. In another experiment he mounts a salted flame between and in contact with two unsalted flames, in one of which an electrode is fixed. A movable electrode plunges into the other flames, and as soon as it touches the salted flame the conductivity goes up abruptly, to a great extent if the electrode is negative, and to a small extent if it is positive. This unipolar conductivity is analogous to that of a mass of hydrogen surrounding a carbon filament. The author believes that the presence of a metallic conductor is essential for ionizing a vapor.—*Comptes Rendus*, November 24; illustrated in Lond. *Elec.*, December 19.

Crystallization from an Electrolyte.—HEYL.—An account of an experimental investigation. Having failed to find any effect produced by electrostatic stress upon crystals formed under its influence, he investigated the effect produced upon crystals formed from an electrolyte carrying a current. The results are likewise entirely negative. Two substances were used: copper sulphate in an aqueous solution and mercuric iodide in concentrated hot hydrochloric acid. The passage of the current produces no effect comparable with that produced by the heating of the solution.—*Phys. Rev.*, December.

REFERENCES.

Ionization of Air in Caves.—EBERT AND EWERS.—An account of experiments in which they repeat and continue similar experiments of Elster and Geitel. They find that underground air is not like "activated" air, but rather resembles radium and thorium compounds, which, while neutral themselves, are capable of ionizing gases by means of the free ions they emit.—*Phys. Zeit.*, December 1; abstracted in Lond. *Elec.*, December 12.

Change of Length and Thermo-electric Power by Magnetization.—RHOADS.—An article describing experiments showing that there exists a relation between the changes of length and the changes of thermo-electric power caused by magnetization.—*Phys. Rev.*, December.

ELECTRO-CHEMISTRY AND BATTERIES.

Electrolytic Alkali Industry.—J. B. C. KERSHAW.—The conclusion of his illustrated article. He discusses the electrolytic alkali industry in the United States, and makes brief remarks on some American companies, but gives nothing new, nor is his review complete. Some general remarks on the financial conditions of the electrolytic alkali industry and the rivalry of the older Le Blanc process are added. The fall in the selling value of bleaching powder, while it will seriously curtail the profits of the Le Blanc works, will not cause actual loss in the manufacture, and continued competition from this quarter must be expected by the electrolytic alkali companies. The author reaches the conclusion that the total cost of 1 ton 72 per cent. caustic soda and 2.1 tons 35.0 per cent. bleaching powder by the best electrolytic processes is about $70, while the present selling price in 1903 will be $86.25. The prospects of the electrolytic alkali works are, therefore, not so hopeless as their rivals are disposed to believe.—Lond. *Elec.*, December 12.

Electrotype Reproductions of Phonograms.—AZOULAY.—A description of two methods by which any number of duplicates may be made from a single original phonogram (meaning the wax cylinder of a phonograph), which, however, is destroyed in the process. A mould is taken of the original cylinder by electro-deposition of copper on the original, and the mould, which must be 2 mm or 3 mm thick, is subsequently nickeled. This mould forms the basis of both the processes. In the first process the mould is mounted on a mandril in the shape of a truncated cone, and wax is poured in and allowed to cool very gradually, the mandril being withdrawn at the proper moment. In the other process a hollow cylinder of wax, somewhat shorter and narrower than the interior of the mould, is placed inside the latter, and heated and pressed against it from within by means of a rubber bag inflated to some eight atmospheres, or by hydraulic pressure. "After cooling, the wax detaches itself in both cases from the copper mould, and the latter is ready for another reproduction."—*Comptes Rendus*, November 17; abstracted in Lond. *Elec.*, December 5.

Making Ozone for the Sterilization of Water.—A description of two German plants installed by Siemens & Halske, in Wiesbaden and Paderborn, and of a plant in Holland using another system; a description by van't Hoff of the latter has already been abstracted in the Digest. In the two German plants the Siemens & Halske

ozonizer is used, which consists of two concentric metallic tubes separated by a glass tube; cooling water flows through the inner tube and the silent discharge occurs in the air space between the glass and the outer metallic tube. At Wiesbaden the ozonizers are 48 in number, and are arranged in two sets of 24 each, the ozonizers which are of the tube type, have one pole earthed on account of the water used for cooling purposes. The tubes are contained in closed cast-iron boxes divided into three compartments, the upper one of which contains the high-potential current connections and the air inlets to the tubes; the middle compartment contains the glass ozonizing tubes with the metallic envelopes, and the lower compartment acts as a reservoir for the ozonized air. These cast-iron boxes are provided with glass windows in the tops, fronts and bottoms, so that it is possible to observe the color and character of the electric discharge, and in this way observe the proper operation of the ozonizers. The high-potential conductors are carefully protected from all possibility of contact. Alternating current at 8,000 volts is used. In an editorial discussion of these installations it is pointed out that the problem of the purification of water by ozone is an economic one and the important data are the cost per cubic meter of water. The average cost in the three installations is 7.46 cents per 1,000 cubic feet. It is said that until this cost is reduced, it is doubtful whether the process can come into general use.—Lond. *Elec.*, December 5.

Aluminum Anode.—TAYLOR AND INGLIS.—An abstract of a (Brit.) Phys. Soc'y paper in which they first call attention to the fact that aluminum is very slowly acted upon by dilute sulphuric acid even at moderately high temperatures; but with dilute hydrochloric acid or when a little hydrochloric acid or some soluble chloride be added to dilute sulphuric acid, the action is violent. This peculiar phenomenon is thought to be connected with the other well-known fact that when an aluminum electrode is used as anode in a solution of a sulphate or of sulphuric acid, there is a very great resistance which does not exist when the aluminum plate is cathode or when other acids are substituted for sulphuric acid; and this is generally supposed to be due to an insulating film. The authors endeavor to explain both phenomena as being due to the same cause, and conclude that the origin is that the film of aluminum hydroxide on the anode is permeable to certain ions, but impermeable to others. They made experiments on the rate of diffusion of various ions through a film of aluminum hydroxide, and found that several salts of potassium diffused rapidly through such a film, but the sulphate passed through very slowly.—Lond. *Elec.*, November 28.

Conductivity of Electrolytes.—KUNZ.—An account of experiments with concentrated solutions of sulphuric acid, caustic soda and calcium chloride which have very low freezing points. With a 45 to 70 per cent. solution of sulphuric acid, temperatures below 70° could be attained and measured by means of a constantan iron couple. His measurements show that the conductivities of all of these do not converge to zero at 39°, as Kohlrausch supposed, but more likely at absolute zero, thus representing the reverse of the case of the pure metals, whose resistivities converge to zero at the same point.—*Comptes Rendus*, November 10; abstracted in Lond. *Elec.*, November 28.

REFERENCES.

Limits of Electrolytic Conductivity.—BONSFIELD AND LOWRY.—A paper in which they show that electrolytic conductivity has a lower and an upper limit quite apart from that due to freezing or boiling. At the lower limit the viscosity of the solvent stops the motion of the ions, and at the upper limit the solvent loses its ionizing power. —*Proc. Roy. Soc.*, October 17; abstracted in Lond. *Elec.*, November 28.

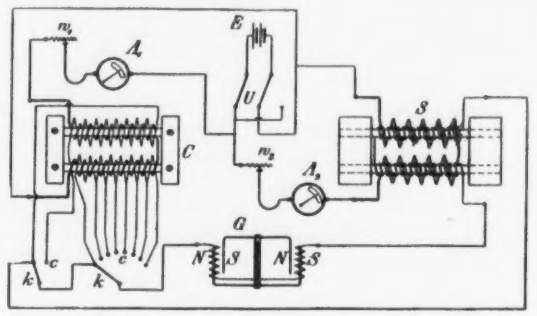
High-Temperature Electro-Chemistry.—HUTTON AND PETAVEL.—The first part of a (Brit.) Inst. Elec. Eng. paper in which he describes the electro-chemical laboratory of Owens College and also gives some notes on actual electro-chemical processes.—Lond. *Elec.*, December 12.

Electrolytic Rectifier.—GUTHE.—His paper in full on the theory of the electrolytic rectifier, an abstract of which was recently noticed in the Digest.—*Phys. Rev.*, December.

Electric Manufacture of Steel.—REYVAL.—An illustrated description of the Harmet process.—*L'Eclairage Elec.*, November 15.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Compensation Magnetometer.—CORSEPIUS.—An illustrated description of an instrument for testing the magnetic properties of iron. Two small iron rods are connected together by end pieces, so that a closed magnetic circuit is formed. Around each rod a primary coil is wound with a secondary above it; contact knobs enable one to disconnect any portion of this secondary. The arrangement of the whole test is seen from the adjoining diagram. Direct current from the source of current *E* flows through the magnetizing coil of the sample of iron introduced in *S;* another direct current flows through the primary coil of *C*, which apparatus was described above. By means of the switch *U* both currents are simultaneously reversed, and the current is measured in the circuit formed by the oppositely



COMPENSATION MAGNETOMETER.

connected secondary windings of the sample iron, *S*, and the auxiliary apparatus, *C*, *G* being a measuring instrument of special construction. By adjusting the levers, *k* of *C*, this current is made zero. *G* is a needle galvanometer, the movable part of which consists of two U-formed magnetic rods, the one embracing the other from the outside in the opposite direction, so that the opposite poles of both rods are near each other. The ends of the one rod are surrounded each by a thin coil; the astatic system is bifilarly suspended and has a needle; great sensibility and mechanical compactness are claimed for the instrument.—*Elek. Zeit.*, November 13.

High Carbon Resistances.—LONGDEN.—A long article describing some methods of making high resistances of carbon. For instance, he mixes 10 grammes of pipe clay and 2 grammes of flake graphite with 10 cc of a 20 per cent. solution of ordinary granulated sugar; the moist clay is then pressed into cylindrical sticks about 5 mm in diameter; these are thoroughly dried in an oven at 150° and then carbonized by keeping them at a red heat 8 hours in a covered crucible, packed with graphite. The graphite used in this method may also be omitted so that the resulting sticks contain no carbon except that which is furnished by the sugar. The resistance of the carbon sticks made by the first method was from 1,000 to 5,000 ohms per cm, while that of those made by the second method was several megohms per cm. One of the objections to these resistances is the rapid increase of resistance with time. A more serious objection proved to be the unreliable character of the junctions between the carbon sticks and their terminal wires. He succeeded, however, in electroplating copper terminals to the clay carbon sticks; this is easily done by passing the current from the anode through the solution to a fine copper wire twisted several times around the end of the carbon stick; the copper is at first deposited only upon the copper wire, but in a short time it begins to creep out over the surface of the clay carbon stick and forms a perfect coating, the contact between the copper and the carbon being fully satisfactory. A more satisfactory form of carbon resistance consists of a film of smoke deposited upon a strip of glass; camphor smoke appears to give more nearly uniform results than candle smoke or smoke from a gas jet. A film 5 cm long by 1.5 cm wide may have any resistance from about 50,000 ohms to about 100 megohms. In order to get good contacts between the carbon and the terminal wires, he uses the following method. The ends of the glass strip are first coated with metallic silver, chemically deposited, and then the resistance material is deposited in a uniform layer over the entire surface of glass and silver. The silver tips may be thick enough to stand electrolytic depositions of copper at the extreme ends, or they may even be made so thick that fine copper wires may be soldered directly to the silver. On account of the extreme delicacy of a film of smoke upon glass, it is necessary to protect this film; a simple bath in alcohol vapor is sufficient to harden a smoke film to such an extent that it may be further protected by flowing upon its surface a coat of shellac varnish, India rubber varnish, or melted paraffin. The resistance of such silver-tipped smoke films is considerably more

constant than that of the clay-carbon sticks with copper-plated terminals, mentioned before.—*Phys. Rev.*, December.

Theory of the Wehnelt Interrupter.—KLUMPATHY.—A note on a paper presented to the Hungarian Academy of Sciences. The interruptions in the Wehnelt interrupter are caused by the development of steam in the acid which then acts as an insulator. Simon had explained the steam production as being due to Joulean heat. The present author shows that this explanation is not sufficient and that the Peltier effect plays an important part. A platinum electrode in sulphuric acid is heated as anode and cooled as cathode by the Peltier effect. As a rule the thin wire is made the anode of a Wehnelt interrupter, so that Joulean heat and Peltier effect here act together, producing a high temperature and causing a strong generation of steam. If the wire is made the cathode, it will be cooled by the Peltier effect, though it will receive its share of the Joulean heat. There will furthermore be a liberation of hydrogen at the cathode, and a voltaic arc will play between the cool wire and the warm, well conducting acid, provided the current intensity be high; as a result the wire cathode will be liable to fuse. If the currents are not very strong, the wire cathode will not make a very good Wehnelt interrupter. Klupathy further observed that the frequency of the interruptions of a wire anode which was not pointed, was increased when the electrode was especially heated by a branch current. As regards condensers and self-induction, he finds that when the condenser is joined in parallel to the interrupter, the frequency will rise if the anode wire is thin and the self-induction small, but will diminish if the wire is thick and the self-induction considerable. In his opinion, the process could then be explained in the following way: The heat produced in the wire electrode, both Joulean and Peltier, evaporates the acid in its immediate neighborhood; the steam generated insulates the electrode, and interrupts the current momentarily; the extra current then strikes through the steam, the spark re-establishes the circuit, and the phenomenon repeats itself.—Lond. *Eng'ing*, December 5.

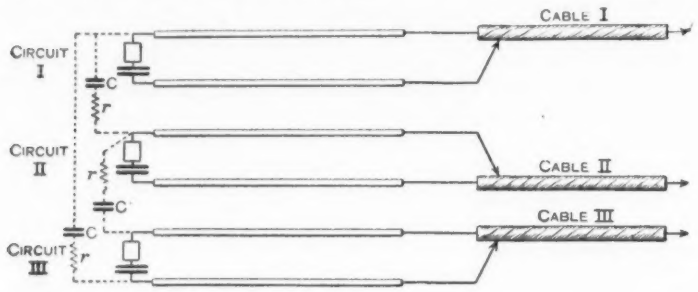
REFERENCES.

Testing Laboratory.—UPPENBORN.—A well-illustrated description of the electric testing laboratory of the municipal electric central station of Munich, for testing and replacing meters, making photometric measurements of lamps, testing insulation materials and general testing purposes.—*Elek. Zeit.*, November 27.

Electromagnetic Brake.—An illustrated description of the eddy current brake, devised by Pasqualini for testing motors, etc.—*Elek. Anz.*, November 20.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Disturbances on Underground Cables.—SCHOENAN.—An account of some troubles experienced on certain lines in China. Until 1901 the telegraph cables terminating at Woosung were connected with the Shanghai office by an ordinary overhead land line about 9 miles long. As this line was the cause of endless disturbances on account of contact and induction, it was found advisable to replace the line by an underground cable consisting of seven cores enclosed in a lead tube, one core being a spare one and the other six being connected in pairs to three seagoing cables at Woosung. Return earth to Woosung being used on all three circuits, it was not considered necessary to cover the cores with brass tape or a similar metallic coating in order to prevent induction. It was, however, soon discovered that a very considerable interference, partly due to induction and partly to interference between the earths at Woosung, took place between the circuits. A remedy was found by introducing an "induction balance" as illustrated in the adjoining diagram, in which *r* are resistances and *C* condensers; in this particular case the condensers, *C*, had a capacity of about 0.1 microfarad, the resistances *r* were about 100,000 ohms, and the resistance of the seven cores about 220 ohms each. He thinks that a similar "induction balance" would be of use, not only on underground cables where metallic circuit is not used—it may even perhaps in some cases be used as a substitute for a metallic return—but also on long overhead lines, where induction is felt.—Lond. *Elec.*, December 19.



INDUCTION BALANCE FOR UNDERGROUND CABLES.

MISCELLANEOUS.

Training of Electrical Engineers.—FELDMANN.—A long abstract of a lecture discussing the principles upon which the education of an electrical engineer should be based. He believes that the foundation should be a broad one; specialization should not begin too early. The student should be well equipped in mathematics; he thinks that the difficulties of the practical introduction of the three-phase system in England were mainly due to the lack of mathematical training of English engineers; he thinks that while in France mathematical education is highly developed, the geometrical methods are neglected in favor of purely analytical methods. A good knowledge of physics and chemistry is required and the study of foreign languages is strongly recommended. "For the (German) electrical engineer the knowledge of the English, American or French technical literature becomes more and more a necessity; that of the French literature on account of the theoretical investigations, that of the English and especially American literature on account of the daring and magnificent enterprises." The practical training should be in the first part of the time the same as that of mechanical engineers. He refers to the proposal to require a year of practical work, before a student can get his degree; this is necessary to show the student what a drawing must look like, in order to be understood by the workingman; it shows him the different steps of the manufacture of a certain machine or apparatus; for this purpose training in a small factory is better than in the plant of a large factory. The student should also be taught the principles of business and commerce.—*Elek. Zeit.*, December 4.

REFERENCE.

Biographical.—A biographical sketch, with portrait, of T. A. Edison.—*Sc. Am.*, December 27.

New Books.

TRANSACTIONS OF THE AMERICAN ELECTROCHEMICAL SOCIETY. Volumes I and II. Being the Proceedings of the Inaugural Meeting at Philadelphia in April, and of the Second Meeting, at Niagara Falls, in September, 1902. Philadelphia: Published by the American Electrochemical. Vol. I, 249 pages; Vol. II, 274 pages. Price, each volume, $3.00.

These volumes are splendid evidences of great activity in the formation of a society, in the first year of life enrolling 433 members, of whom 355 were charter members. The membership extends to Russia in the East and to Honolulu and Australia in the West.

The papers printed in these transactions are, in general, excellent in character. The discussions as printed do not, however, appear to have been very animated, although there are a few papers that are well discussed. The papers vary from dissertations of purely theoretical electro-chemical phenomena to descriptions of practical processes. The mingling of practical and theoretical topics causes the *Transactions* to have a wide range of value.

Among the most valuable theoretical papers are those discussing the nascent state, and the phenomena of concentration cells. Several of the practical papers discuss continuous furnaces, and an excellent paper by Mr. Hugh Rodman gives a resumé of the present state of the storage battery art. These *Transactions* will be eagerly read by the student and worker in electro-chemistry.

MOTOR CARS. By Rhys Jenkins, M. E. New York: James Pott & Co. 370 pages, 100 illustrations. Price, $5.

That the subject of automobiles must create a very large literature of its own becomes increasingly evident. The bicycle once did this also, but there are very few new bicycle books nowadays. We do not believe that the bicycle era has definitely closed, but it seems probable that the literary opportunities of the machine, technically considered, are pretty well exhausted. Unless we err greatly, the contrary is the case with the automobile. That machine affects so many fundamental interests in society and industry, and is susceptible of so many feasible variations in type, design and application, we

can readily entertain the opinion that in time it will be as prolific a theme as the steam engine or the dynamo.

Just now the literature of automobilism is passing through the historical and rudimentary stage, when every author feels almost constrained by a sense of duty to sum up what has been attempted, and like the Offenbachian burgomaster begins his address with, "The Year One——"; while in treating the subject at its present point he is equally compelled by a desire to be fair and comprehensive to include many forms that are mere freaks and are as sure to disappear as the bad roads, now giving them such swift dispatch and such slow advance. After all it is as well that these historical records should be compiled while the materials and the pioneers are accessible. It is likewise not amiss that even the oddities and crudities of the earlier years should be set down and noted, extinct monsters in a museum of mechanical antiquities.

Mr. Jenkins has performed admirably in this portly and handsome volume the task which he set himself, and has crammed into pages that are a pleasure to the eye as well as a constant source of instruction, an amazing amount of data. As we have intimated, he bows profoundly to the historical fetich and rather than sin by omission is overkind to some machines the world would willingly let sink into oblivion. Another point of fair criticism is that he is curiously uninformed as to the latest work in electric automobiles, still very strongly in the running; and also has a lot to learn about what is doing in America, what men like Riker, Sperry, Maxim, Baker, Condict and others have attempted and achieved. But we can heartily commend the book to American readers for what it contains as to the subject in general and as to a great deal of recent European development in particular. The book, of British origin, is, moreover, an encouraging sign that England is wider awake on this important subject, and that a country which has been active in filling the world with locomotives, plows and lathes is to do something in meeting the twentieth century demand for autos.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings: January 23d, 1903, "Telephone Exchanges"; February 27th, "Railway Train Lighting," Wm. L. Bliss, Lamar Lyndon and A. J. Farnsworth; March 27th, "High-Tension Lines," Ralph D. Mershon; April 24th, "Tendencies of Central Station Development," H. A. Lardner, Philippo Torchio and Peter Junkersfeld.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES, Secretary, W. H. Johnson, Philadelphia, Pa.

CANADIAN ELECTRICAL ASSOCIATION, Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Toronto, Ont., 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association), Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

ENGINE BUILDERS' ASSOCIATION, F. P. Ide, Springfield, Ill., Secretary.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION, Secretary, E. M. Coleman, Louisville, Ky. Next meeting, Chicago, December 9, 10 and 11, 1902.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION, Secretary, H. K. Cole, of Lancaster, Ky.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES, Secretary, W. H. Morton, Utica, N. Y. Next meeting, Detroit, Mich., July 15, 1903.

NATIONAL ELECTRIC LIGHT ASSOCIATION, Secretary, James B. Cahoon, 136 Liberty Street, New York. Next meeting, Chicago, May, 1903.

NEW YORK ELECTRICAL SOCIETY, Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION, Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, Milwaukee, January 21, 1903.

SOUTHERN INDIANA TELEPHONE ASSOCIATION, Secretary, E. W. Pichardt, Huntingburg, Ind.

Electric-Pneumatic Control on the Brooklyn Elevated Railway.

As intimated in these columns last week, the Brooklyn Elevated Railway Company has given an order to the Westinghouse Electric & Manufacturing Company for 210 multiple train-control equipments for the operation of electric trains. A few years ago the management of this road decided to discard steam locomotives and to operate all trains electrically. Before making such a wholesale change, however, it was deemed prudent to test exhaustively the different methods of handling electric trains. If the steam locomotives were to be replaced by simple electric locomotives, many of the advantages of electric traction would be sacrificed. In order to reduce the dead-weight hauled and to obtain a higher tractive

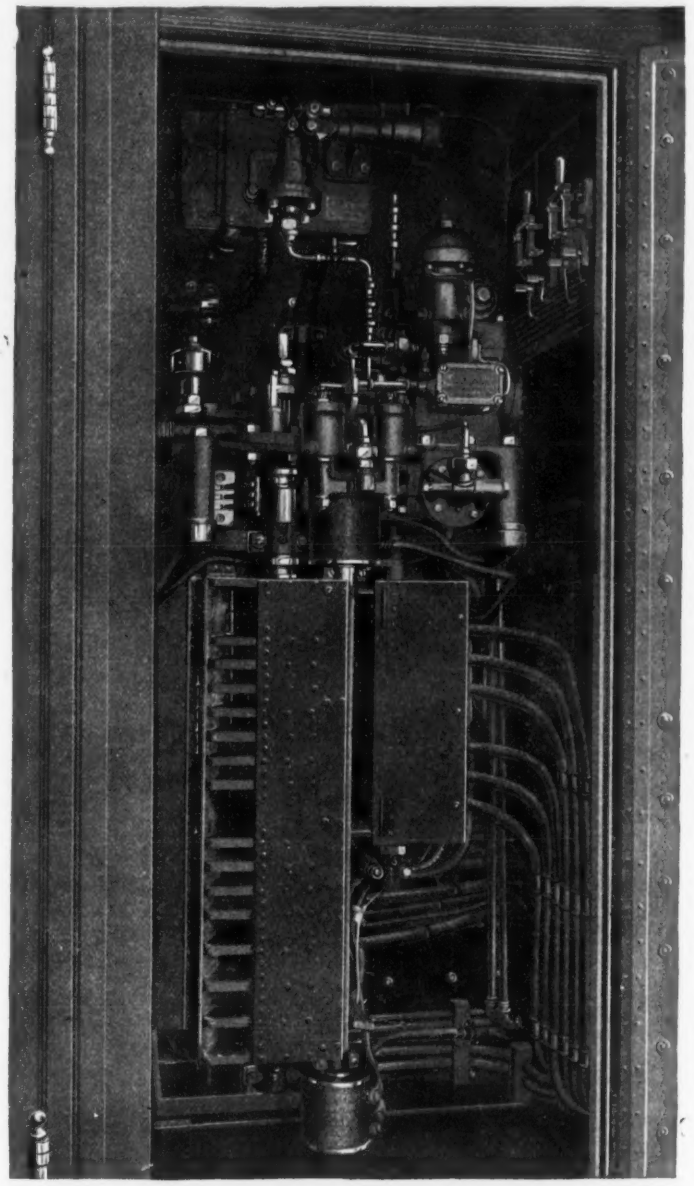


FIG. 1.—VIEW OF CONTROLLER COMPARTMENT, OPEN.

effort when starting, it is better to place the driving motors on the trucks of several of the passenger cars of a train and thus take advantage of the weight of the cars than to put the motors on a locomotive, which must be artificially loaded down to give it the necessary adhesion. Other reasons for choosing a system employing a number of motor cars per train rather than a single locomotive were that, since the service is fluctuating, during a part of the day the large motors of the locomotive would be operated at a light load and consequently low efficiency. Moreover, the trains could not be broken up into single units, as is possible when a number of the cars carry their own motor equipments. This reasoning is familiar to our readers and need not here be expanded.

The Brooklyn Elevated Company, therefore, went to the leading electrical manufacturers who had developed systems for controlling a number of motor cars in a train, and asked them each to equip a

number of model trains for testing purposes. These trains were placed on the Brooklyn road a few years ago and have since operated in the regular daily traffic. Careful records were kept of the number of miles run by each train, the number of accidents met with, the cost and time required for repairs, the comparative convenience in operation, and all other matters that might influence the decision. The result of this investigation has been the placing of the order mentioned above. All steam locomotives now in use will be in a short time replaced. In addition to the order for 210 cars, the company has already purchased about 150 equipments which have been in satisfactory operation for nearly a year.

The Westinghouse multiple train control system has been developed by Mr. George Westinghouse. It involves the use of compressed air for moving the current-controlling apparatus, electro-magnetic valves governing the admission of air to the controlling cylinders and low-voltage electric circuits running from car to car for controlling the action of the magnet valves. The connections for the low-voltage

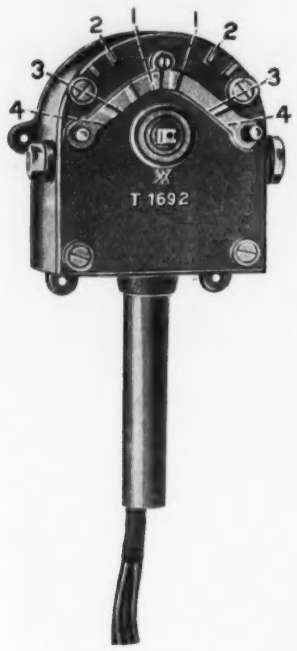


FIG. 2.—MOTORMAN'S CONTROLLER.

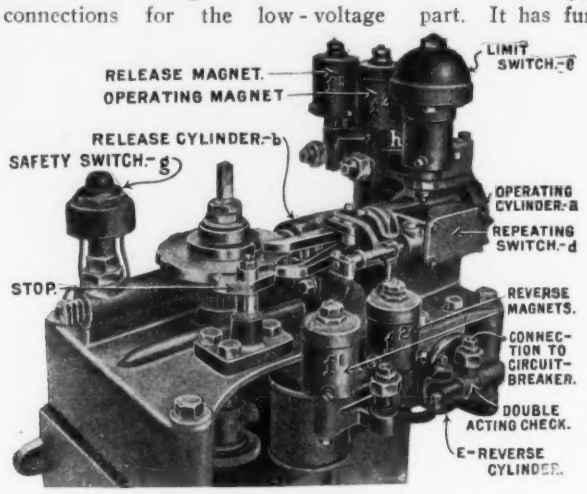


FIG. 3.—TOP OF CAR CONTROLLER.

power from some of the cars, while in this electro-pneumatic system there are a number of ways in which that may be accomplished, greatly reducing the possibility of accident. Both controllers and circuit-breakers are opened by a snapping in two of the train, this action being independent of and in addition to the effects obtained by the application of the air brake. The controllers may be operated by hand, thus permitting the train to run to a terminal station in case of any derangement of the controlling apparatus. The operation of both brakes and controllers is effected by a single air-hose connection between the cars, the air compressor which furnishes air for the brakes also furnishing air used to operate the controllers.

The Brooklyn Elevated will equip all its new cars with four motors each. The 150 cars now in use equipped with the Westinghouse system have each two motors. The trains on the road are made up of five or six cars, two or three of which are usually motor cars. When these trains reach the suburbs they are broken up into smaller units of one or two cars, each of course containing a motor car, and the smaller trains branch off on different divisions.

In the great transportation problems which are being solved in New York City, the Westinghouse Company has borne a prominent part. It has furnished the power equipment of the Brooklyn Elevated, also the power equipment of the Manhattan Elevated, including eight of the largest generators ever built. It has contracted to furnish the power equipment of the Rapid Transit Subway,

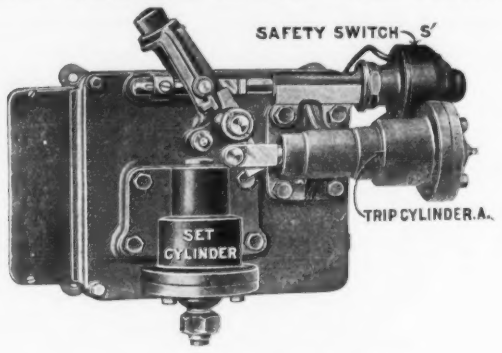


FIG. 4.—CIRCUIT BREAKER.

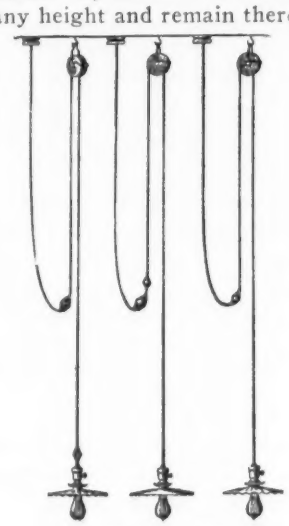
circuits are the only ones which have to be established between the cars of the train, no air connections being required outside of the ordinary brake hose. A complete equipment for each motor car consists of two or four electric motors, a controller very similar to those used on ordinary street cars, and one or two motormen's controlling switches, from any one of which all the car controllers on the train may be operated. The car controller consists essentially of two drums which revolve in bearings, and stationary contact fingers which make contact with points upon the revolving drums. The large, or main, drum opens the main circuit and makes the motor and resistance combinations; the small drum reverses the motors. A multiple control switch is placed at one or both ends of each motor car and by means of the one at the front of the leading car the motorman controls the action of the controllers on all of the motor cars in the train. The system uses the standard type of controller and standard types of valves and magnets, the latter having been used for years in the operation of the Westinghouse electro-pneumatic system of switches and signals upon the largest railways of the world. It is the only system in which the control circuit is isolated from the main power circuit. The control circuit is, therefore, not affected by a momentary interruption of current due to ice and sleet on the rails, or other causes. With the low-voltage current, grounds and short circuits at the connectors between the cars during stormy weather or fires resulting from high voltage circuits through the train are, it is said, entirely eliminated. The current for the motors is simply collected from the third rail, led through the local car-controlling apparatus to the motors, and then back to the service rails, and does not pass from car to car. The controlling apparatus is so located that the motorman may have convenient access to all parts from the platform.

The motor circuits on any car are automatically opened in case of excess current, and they can all be simultaneously closed at the will of the motorman. All controllers are automatically turned off by the application of the automatic air brakes, which is an important point since in case of a train breaking in two the brakes are automatically applied and at the same time the power is shut off. Under old conditions, it has often been found impossible to shut off the

the power house of which will contain six units similar to those furnished to the Manhattan people, while the Brooklyn Elevated contract indicates a further advance in dealing with the train control situation.

Lamp Adjuster.

Skelly & Company, Electric Building, Cleveland, are introducing a new type of lamp adjuster for incandescent lamps, known as the "Acme" adjuster. By means of a balance weight the lamp may be placed at any height and remain there until moved. The



LAMP ADJUSTER.

counterbalance is applicable for any weight of lamp or shade. For window display illumination the device is especially adaptable, allowing for the changing of design as often as desired without trouble or expense. It is also useful in shops and offices, avoiding the necessity of a multiplicity of lamps because of the wide range over which one lamp can be used without entanglement of wires.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money closed at 6 per cent. for 60 to 90 days. There was activity in stock speculation with general advances. Manipulation by large interests was apparent, but public interest has increased and sales to secure profits are quickly absorbed. Among the features were Amalgamated Copper and the traction group. The former advanced from 59½ to 66, on the belief in brighter prospects for that and other copper stocks. On reiterated reports of a combination of traction interests in Greater New York, Manhattan and Brooklyn Rapid Transit, together with Metropolitan, made a decided advance. Manhattan closed at 149, thus making a net gain of 2¾; Metropolitan gained 1⅛, closing at 141, and Brooklyn Rapid Transit, receding, closed at 66½, a net loss of 1⅝ points. The electrics made substantial gains, General Electric closing at 184½, being a net gain of 6⅝, the trading being rather limited. Westinghouse com. closed at 212, being a net gain of 17½, and preferred at 215, a net gain of 13 points. Western Union made a gain of ⅜ point, closing at 88⅜. American Dist. Tel. closed at 40¼, a net gain of 2¾. Following are the closing quotations of January 6:

NEW YORK.

	Dec. 30.	Jan. 6		Dec. 30.	Jan. 6
American Tel. & Cable	86	85	General Electric	177⅛	189⅜
American Tel. & Tel.	164	163	Hudson River Tel.	..	..
American Dist. Tel.	37½	38	Metropolitan St. Ry.	140⅛	142⅛
Brooklyn Rapid Transit	67¾	69⅝	N. E. Elec. Veh. Trns.	..	..
Commercial Cable	169¾	..	N. Y. & N. J. Tel.	161	..
Electric Boat	22	30	N. Y. E. V. T. Co.	9⅛	11
Electric Boat pfd.	35	42	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	3	3	Western Union Tel.	88¼	90
Electric Vehicle	3½	5	Westinghouse com.	202	218
Electric Vehicle pfd.	9	11	Westinghouse pfd.	202	222

BOSTON.

	Dec. 30.	Jan. 6		Dec. 30	Jan. 6
American Tel. & Tel	164¼	163½	Western Tel. & Tel. pfd.	99	99½
Cumberland Telephone	124⅜	127	Mexican Telephone	2	2
Edison Elec. Illum.	262½	..	New England Telephone	138	138
General Electric	..	..	Westinghouse	99	107
Western Tel. & Tel	..	24	Westinghouse pfd.	99	107

PHILADELPHIA

	Dec. 30.	Jan. 6		Dec. 30.	Jan. 6
American Railways	51½	52½	Phila. Traction	97⅝	98¼
Elec. Storage Battery	*84	80	Phila. Electric	8⅛	8¾
Elec. Storage Battery pfd.	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	9½	10	Pa. Electric Vehicle pfd.	..	..

CHICAGO.

	Dec. 30.	Jan. 6		Dec. 30.	Jan. 6
Central Union Tel.	..	..	National Carbon pfd.	97	97
Chicago Edison	175	..	Northwest Elev. com.	..	..
Chicago City Ry.	205	208	Union Traction	14¼	15¼
Chicago Tel. Co.	..	..	Union Traction pfd.	45	45
National Carbon	26	26			

*Asked.

LARGE TROLLEY EARNINGS.—Since January 1st last the Detroit United Railway Company has each month reported gross and net earnings larger than those of the corresponding months a year ago, and at the end of eleven months has an increase in gross earnings to its credit of $409,477, of which $260,270 is absorbed by increased operating expenses, leaving $149,206 as net increase. Fixed charges for the period are $68,344 larger than for the corresponding period a year ago and the surplus shows an increase of $68,344. The surplus after charges for eleven months is $664,395, which is equivalent to 5.3 per cent. on the $12,500,000 outstanding. Twin City Rapid Transit's business in November contributed an increase in gross earnings of $40,951, bringing the gross gain of the year to date to $401,246. In the eleven months expenses were increased $177,369, leaving a gain in net earnings of $223,877. The surplus after fixed charges and the eleven months' proportion of preferred dividend which have been deducted is $958,466, or over 5¾ per cent. on the common stock. An increase of $17,960 in gross earnings is shown by the statement of the Montreal Street Railway for November. In two months of the current fiscal year gross earnings have increased $33,304 and net earnings $14,957, while surplus is $12,240 larger than for the same period a year ago. In the year ended September 30th last the company earned almost exactly 10 per cent. on its stock and the increase in surplus indicates that just about 10¼ per cent. is now being earned.

GENERAL ELECTRIC.—Reports from Boston state that earnings of the General Electric Company for the fiscal year ending January 31 will, it is understood, show about $10,500,000 net. It is now rumored in Boston also that while it is quite likely that the General Electric Company will take over the Stanley Electric Company, any such absorption will not include the Electric Storage Battery Company, as the General Electric Company directors are unanimously opposed to taking over this company at any price. The Whitney-Ryan-Roebling interests control both the Stanley Electric and the Electric Storage Battery companies. They have had under consideration a consolidation of these two companies, it has been reported, for some time, and have been willing to dispose of them to the General Electric Company. Negotiations to this end have been going on for some time, but the Whitney-Ryan interest, while seeking to include the Storage Battery Company in the purchase, have not met the views of the General Electric Company as to an equitable price for the Stanley Company by itself. It is understood that the upset price fixed by the General Electric Company is about $2,500,000, or $125 per share for the $2,000,000 capital stock of the Stanley Company, and indications are that the trade will shortly be closed. The Stanley Company is said, however, to have more money invested in it than the sum just named. It is doing a very large business.

BELL TELEPHONE FINANCES.—Note is made elsewhere of the proposed increase of the capital stock of the New York Telephone Company from $30,000,000 to $50,000,000. The increase of capital stock of the subsidiary companies of the American Telephone & Telegraph Company from time to time has aroused interest as to the money requirements for the year 1903. The Cumberland Telephone Company, which operates throughout Tennessee, Kentucky and other Southern States, is asking authority of stockholders for an increase in its capital stock from $10,000,000 to $20,000,000, and as the American company owns 52 per cent. of the capital stock of that company, it will be called upon to furnish $5,200,000 of the increase, although the new stock may not all be issued in one year. It is estimated that the Bell telephone companies alone will require $25,000,000 in 1903 for extensions throughout the United States and Canada. This sum will put in about 200,000 new subscribers and build the necessary long-distance lines. Of the $25,000,000 the minority stockholders of the subsidiary companies will furnish $10,000,000 and the parent company $15,000,000. Most of the capital furnished by the subsidiary companies will be through stock issues, although there may be small bond issues. The American Telephone & Telegraph Company is expected to benefit its stockholders about midsummer by issuing new stock at par to provide for its needs. The stock is now selling easily around 160.

NEW YORK TRACTION FINANCE.—The statement is made that the Rothschilds have invested $10,000,000 in the Interborough Company, organized to provide rapid transit for New York. This is a larger sum from any other one interested in the company has put up. In mentioning this fact, the *Wall Street Journal* says: "If it were not for capital outside of New York hardly any of the improvement in transit facilities in New York would have been so far possible. It will be remembered that the Metropolitan Street Railway system itself is developed by Philadelphia capital. The opening up of Greater New York by the Pennsylvania Railroad is by outside capital. It may be said that the Manhattan Company alone has had most of its money contributed by local people, but it may also be said that the Manhattan Company, whether from this cause or not, has, nevertheless, had more trouble in pushing improvements and making headway against the powers that be in this city than all the other companies put together."

THE PHILADELPHIA COMPANY owning several electric lighting properties, etc., has had a very successful year, as shown by the increase of $1,437,028 in gross earnings for the eleven months ended November 30th, and that it has been very generous in the operating expenses is indicated by an increase of $1,038,078 in that item for the same period. The company's income other than that derived from direct operation increased $1,036,394, of which $969,253 is contributed by the increase in dividends received on stocks of sub-companies owned. This increase in income from sub-companies is, however, largely offset by an increase of $670,257 in interest on funded debt and an increase of $108,988 in preferred dividend requirements, leaving surplus $17,689 larger than last year. But the amount of this surplus belonging to the minority stockholders in properties of the Philadelphia Company is $461,791 less than last year, so the final surplus is $379,478 larger than last year.

CHICAGO TROLLEY CONSOLIDATION.—With regard to the rumors already noted in these pages respecting a consolidation of all the Chicago street railways, it is now stated that such a plan, to include the elevated roads, is being consummated. It is said that the

capitalization of the new combine will be placed at $270,000,000 and that Lyman Gage is to be president and have associated with him Marshall Field, C. T. Yerkes, Gen. G. M. Dodge and Thos. F. Ryan. The recent employment of John N. Jewett to look into the franchise of the Chicago General Railway Company with a view to its utilization to get around the expiring franchises of some of the street railways is thought to have been a preliminary move in the direction of a general consolidation of all lines and a systematic transfer arrangement between the surface and "L" roads.

CUMBERLAND TELEPHONE.—At the regular meeting of the board of directors of the Cumberland Telephone and Telegraph Company, at Nashville, a resolution was passed calling a special meeting of the stockholders to vote on the proposition of increasing the capital stock of the company from $10,000,000 to $20,000,000. The stockholders have since held the necessary meeting. Stockholders of record January 10 will be entitled to the new stock in the proportion of one new share for every four shares then held. The right to subscribe will expire February 2. Payments for stock are to be made, 25 per cent. February 2, 25 per cent. July 1, 25 per cent. October 1, and 25 per cent. January 2, 1904. The funds derived are to be used to retire a part of the present floating indebtedness and to care for the increased business during 1903.

OHIO STREET RAILWAYS.—The State Railway Commissioner's report for 1902 shows that 28,499,313 passengers were carried, the average distance being 25.54 miles. Total earnings from passenger service, $101,001,341, being an increase over the previous year of 12.6 per cent. The total mileage, including all tracks, is 14,264.05. The common stock proportion for Ohio is $210,335,071; preferred, $100,370,125. The operating expenses showed an increase of 9.04 per cent. Taxes paid by the companies were $2,799,341.17, or an increase of $156,940. Money spent on permanent improvements, $1,063,183, an increase of $449,791. The surplus on hand at the end of the first six months was $9,331,631.63, an increase of over $1,000,000. Salaries of employes show an increase of 12.19 per cent. Tons of freight transported were 132,113,976, an increase of 12.31 per cent.

GERMAN ELECTRICAL FINANCE.—A cable dispatch from Berlin of December 28 says: Prior to the holidays, trading on the Bourse was very light, and values were maintained, but yesterday the trading was uncommonly strong, with an increased volume of business. All departments shared in the upward movement. Electrical shares profited by the alliance of the Allgemeine Electrical Company and the Union Electrical Company. It is said now that the Siemens & Halske Electrical Company, of Berlin, and the Schuckert Electrical Company, of Nuremberg, will make a price arrangement with the new consolidation.

DALLAS ELECTRIC MERGER.—At Dallas, Tex., on December 22, the City Council ended the two months' fight over the street railway merger ordinance by sustaining the mayor's veto. This, for the time being at least, it has been alleged, blocks the plans of the Boston syndicate to consolidate all the Dallas lines into the "Metropolitan Street Railway Company," and float $4,500,000 worth of bonds on the property. Other reports state, however, that the merger plans will be pushed ahead all the same.

NEW YORK TELEPHONE CAPITAL.—The New York Telephone Company, of New York City, has filed with the Secretary of State a certificate of increase of its capital stock from $30,000,000 to $50,000,000. The certificate is signed by Frederick P. Fish, president of the company; Robert C. Clowry, Charles F. Cutter and others. The company's business is increasing at an enormous rate, and it announced recently having attained over 100,000 subscribers.

FINANCING EVERETT-MOORE PROPERTIES.—It is stated that at a conference of Ohio financiers it was decided to form a company to lease several of the properties associated with the Everett-Moore syndicate. The capital of the company will be $2,500,000 and the roads to be included are the Detroit United, the Toledo Railways & Light and the Lake Shore Electric. Dividends will be guaranteed to the stockholders in the two former concerns.

COMMONWEALTH ELECTRIC.—The Commonwealth Electric Company, of Chicago, has voted to increase its capital from five to ten millions. The company is building a very large plant, costing six millions. It will be remembered that this company is virtually an extension of the Chicago Edison Company, which through it controls business in outlying territory.

INDEPENDENT UNION TELEPHONE.—The Independent Union Telephone Company has voted to increase its capital stock from $200,000 to $1,000,000, to connect its system in western New York with properties in the eastern and southern part of the State. Samuel B. Rawson, of Elyria, O., has been re-elected president.

KEYSTONE ATTACHMENTS.—Two attachments, aggregating $74,193, have been granted against the Keystone Telephone Company, Philadelphia, for the National Conduit & Cable Company.

INDIANAPOLIS TROLLEYS.—The stockholders of the Indianapolis Street Railway Company have ratified the lease of the company's lines to the Indianapolis Traction & Terminal Company. The capitalization of the Terminal Company will be increased from $500,000 to $5,000,000. Hugh McGowan was re-elected president.

UNDERGROUND ROAD IN CHICAGO.—It is reported from Chicago that New York and Chicago capitalists have combined to build an underground and a new elevated railway in Chicago at the estimated cost of $51,000,000. The Interborough Rapid Transit Company, of New York, is said to be at the head of the traction plan.

MACON RAILWAY AND LIGHT MORTGAGE.—The Macon Railway & Light Company, of Macon, Ga., has executed a mortgage for $1,000,000 on all its properties to the North American Trust Company, New York, as trustee. This perfects the consolidation of all the street railway and lighting companies of Macon, Ga.

HUDSON RIVER TELEPHONE.—The Hudson River Telephone Company will offer 3,868 shares of new stock at par to stockholders of record, January 10, in the proportion of one new share for every 10 shares then held, the right to subscribe to expire January 31. Payment for new stock is to be made January 31.

BERKSHIRE TROLLEY BONDS.—N. W. Harris & Co. are offering to investors $500,000 first mortgage 5 per cent. gold bonds of the Berkshire Street Railway Company, operating in Pittsfield, Lee, Lenox, Stockbridge, Great Barrington, Cheshire, Adams and North Adams, Mass.

EVERETT - MOORE TELEPHONE.—It is announced from Cleveland, O., that a plan proposed for putting the Everett-Moore telephone properties on a solid financial footing is to organize the United States Telephone Company, of New Jersey, with $10,000,000 capital.

CAMBRIDGE (MASS.) LIGHTING.—The Gas & Electric Light commissioners of Massachusetts have authorized the Cambridge Electric Light Company to issue 1,000 shares of new stock at $140 per share for the enlargement and extension of its plant.

DIVIDENDS.—Directors of the New York & New Jersey Telephone Company have declared the regular quarterly dividend of 1½ per cent., and an extra dividend of 1 per cent., both payable January 15 to stockholders of record January 5.

Commercial Intelligence.

THE WEEK IN TRADE.—The holidays and stocktaking have limited trade somewhat, but satisfaction and confidence are maintained. Wholesale distribution has, according to *Bradstreet's*, been down to a minimum, while retail buying, though satisfactory, feels reaction from previous activity. Perhaps the most notable features are the strength of prices of staples as the year begins and the hopefulness as to the outlook for next spring and summer's trade. The only unfavorable feature noted is the continued shortage of anthracite coal in the East. Reports of increased trade in 1902 over 1901 continue to come from nearly all northern, eastern, western and Pacific Coast points. The outlook for 1903 on the Pacific Coast is almost uniformly favorable and even at the South favorable reports predominate. There is little new in the iron trade. An excellent outlook for a large business and steady prices is noted at Pittsburg. Merchant furnaces are sold ahead from six to eight months, but independent iron men say that high raw materials and low-priced finished products leave them little or no margin for profit. Nearly all lines of trade show gains for 1902 over 1901 at New York, the majority ranging from 5 to 10 per cent. Industry, generally, is active, the demand for labor being large for the season. Wages advances taking effect January 1 were numerous. Railroad men have been special gainers, while the profit-sharing plan inaugurated by the leading iron and steel interest is a notable contribution to the stability of this trade. Prices in copper have been advanced, but there was a very light demand for the metal. Quotations are: Lake, 11.87½ @ 12c.; electrolytic, 11.75 @ 11.87½c.; casting stock, 11.62½ @ 11.75c. *Bradstreet's* notes that 1902 has been a record breaker in the matter of business failures, only 9,971 of these being recorded, with liabilities of $105,693,000 and assets 48 per cent. of this = 5.5 per cent. fewer failures than in 1901, and 19 per cent. less liabilities, the latter being the smallest for twenty years.

STEEL FOR MEXICAN PLANT.—Milliken Brothers, of 11 Broadway, New York, got the contract for the structural steel for the central power plant of the Mexican Gas & Electric Light Company, of the City of Mexico, which is also to be equipped with American machinery.

EXPORTS OF ELECTRICAL MATERIAL.—The following are the exports of electrical materials and machinery from the port of New York for the week ended December 27: Argentine Republic—76 pkgs. material, $1,894. Antwerp—1 pkg. machinery, $60; 19 pkgs. material, $1,111. Berlin—4 pkgs. material, $303; 1 pkg. material, $114. Bergen—1 pkg. machinery, $76. Bremen—1 pkg. material, $150; 1 pkg. machinery, $75. British Possessions in Africa—21 pkgs. machinery, $1,195; 275 pkgs. material, $11,869. British Guiana—35 pkgs. material, $1,373. British East Indies—1 pkg. material, $35; 5 pkgs. machinery, $175. British West Indies —20 pkgs. material, $248; 3 pkgs. machinery, $145. China—11 pkgs. material, $227. Cuba—6 pkgs. machinery, $416; 80 pkgs. material, $1,916; 2 pkgs. machinery, $175. Chili—32 pkgs. material, $2,477. Central America—39 pkgs. material, $507; 9 pkgs. machinery, $603. Danish West Indies—2 pkgs. material, $13. Ecuador—9 pkgs. material, $263. French West Indies—1 pkg. material, $25. Geneva—12 pkgs. material, $132. Genoa—14 pkgs. machinery, $500. Hamburg —1 pkg. machinery, $52; 7 pkgs. material, $444. Hong Kong—14 pkgs. material, $190. Helsingfors—3 pkgs. machinery, $95. Hayti— 1 pkg. material, $11. Havre—3 pkgs. material, $675; 78 pkgs. machinery, $6,000. Japan—15 pkgs. machinery, $1,717; 21 pkgs. material, $1,173. Liverpool—325 pkgs. machinery, $21,760; 31 pkgs. material, $1,933. London—100 pkgs. machinery, $5,631; 148 pkgs. material, $6,011. Mexico—297 pkgs. material, $4,027; 7 pkgs. machinery, $320. Manchester—2 pkgs. machinery, $60. Marseilles— 7 pkgs. material, $350. Newcastle—1 pkg. material, $106. Nova Scotia—24 pkgs. material, $192. Naples—1 pkg. material, $25. Philippines—60 pkgs. material, $433. Reval—4 pkgs. machinery, $947. Rotterdam—1 pkg. material, $32. San Domingo—6 pkgs. material, $42. Sheffield—12 pkgs. machinery, $456. Sunderland—1 pkg. material, $19. Southampton—5 pkgs. machinery, $626; 6 pkgs. material, $154. U. S. Colombia—6 pkgs. material, $1,385. Venezuela —91 pkgs. material, $401. Wigan—1 pkg. material, $94. Following are the exports of electrical materials and machinery from the port of New York for the week ended January 3: Antwerp—8 pkgs. machinery, $720; 18 pkgs. material, $2,451. Argentine Republic—7 pkgs. material, 0893. British West Indies—71 pkgs. material, $475. Bristol—1 pkg. machinery, $76. British Australia—240 pkgs. machinery, $14,424; 30 pkgs. material, $866. Brazil—47 pkgs. material, $2,209. Berlin—2 pkgs. material, $97. British East Indies—11 pkgs. machinery, $525; 3 pkgs. material, $267. Cuba—17 pkgs. material, $386. Central America—7 pkgs. material, $629. Genoa—2 pkgs. material, $85. Glasgow, 20 pkgs. material, $1,299; 2 pkgs. machinery, $81. Halifax—1 pkg. material, $25. Havre—92 pkgs. machinery, $4,000. Hamburg—3 pkgs. machinery, $250; 121 pkgs. material, $3,550. Liverpool—139 pkgs. machinery, $5,448; 25 pkgs. material, $1,417. London—269 pkgs. machinery, $14,127; 238 pkgs. material, $17,315. Mexico—49 pkgs. material, $1,479. Preston—5 pkgs. material, $92. Peru —43 pkgs. material, $2,086. Stettin—12 pkgs. material, $1,032. Southampton—5 pkgs. material, $82; 1 pkg. machinery, $50. U. S. Colombia—3 pkgs. machinery, $42. Vienna—1 pkg. material, $31. Wigan— 1 pkg. material, $100.

ELECTRIC TRACTION FOR MARITZBURG.—Nearly $400,000 is to be expended in the construction of a trolley system in the city of Maritzburg, South Africa. As a first instalment, six and one-half miles of track, part of it double but the major portion single, is to be built. Ninety-pound girder rails will be used in the urban division. In the suburbs a 75-pound rail is to be employed. The initial number of cars will be six. Special designs will be necessary, because the municipal authorities have decided to make a new departure in regard to the seating of Europeans, natives and coolies. In Cape Town, Port Elizabeth and East London there are no restrictions on the use of the street cars by the colored population. In Maritzburg it is proposed that the color line shall be as strictly drawn as it is "Down South." The municipality is not disposed, however, to exclude the natives from the cars, it being the intention to adopt a compromise which is expected to initiate a new usage in street railway economy in South African cities. The cars are to have seats for five natives at each end. The natives will sit behind the motorman in a compartment partitioned off from the rest of the car. The Maritzburg cars are to be 30 feet long. Instead of the trolley the sliding bow is to be used. For the purpose of furnishing energy to operate the road, 400 hp of equipment will be added to the existing plant now used for lighting and power. Skidmore Ashby is the electrical engineer of the municipality.

UNITED TELPHERAGE COMPANY.—Mr. H. McL. Harding, President of the United Telpherage Company, 20 Broad Street, reports a very prosperous year in 1902 for this vigorous and most promising young industry. It has barely been in operation a year, but has already some 40 telpherage plants in operation all over the country, in which the telphers haul aerial loads ranging from a few pounds of freight up to six or seven tons, of all classes of material, including cotton goods, hogsheads, ashes, metal parts, coal, limestone, bags of cement, bottles, etc., etc. A considerable inquiry for this entirely new class of American apparatus has grown up abroad, and not only have foreign plants been sold, but arrangements have been made with very influential concerns to represent it actively in various countries. It already is becoming evident that largely thanks to Mr. Harding's efforts and those of his associates, a new industry has been started of great magnitude; one, indeed, which they expect to compare at no distant date with the trolley art of passenger transportation.

LIGHTING EQUIPMENT FOR SAN LUIS POTOSI.—The Potosina Electric Company, of San Luis Potosi, Mexico, which has succeeded the old San Luis Potosi Electric Light Company, has just awarded contracts through the electrical engineering and contracting firm of Sanderson & Porter, New York, for three 100-kw Westinghouse generators for direct connection to horizontal tandem single crank gas engines of 170 hp capacity each, to be built by the Westinghouse Machine Company, Pittsburg, and the order for which was given to Westinghouse, Church, Kerr & Company. The engines will be operated on Loomis-Pettibone producer gas. The Mexican plant is laid out with a view to the installation of two additional units of 220-kw capacity each. Former General Manager Waddill, of the old company, is president of the new concern, which is composed exclusively of American capitalists, and has the concession for furnishing light to the important city of San Luis Potosi. H. A. Corbitt is the engineer.

MORE YANKEE EQUIPMENT FOR AFRICA.—Bids are now being invited by the New York offices of the British firm of Macartney, McElroy & Co. for the supply of considerable equipment intended for the new Lourenzo Marquez electric traction system, Portuguese East Africa, the contract, valued at over $500,000, for the construction and equipment of which road was recently awarded to the firm. In the first instance it is proposed to build 15 miles of line. The trolley wire is No. 00. The cars will be open, single-deck ones, somewhat similar to the open cars operated on the Metropolitan road during the summer. They will have a capacity for about fifty passengers. Single trucks will be utilized. The motors will be either two 30-hp or two 25-hp for each car. The power house equipment is to comprise two 200-kw generators, which are intended to be direct-connected to high-speed engines.

THE STURGEON FALLS PULP COMPANY, of Ontario, Can., is building a large paper mill which will be operated by alternating-current induction motors throughout. The Westinghouse motors are to be used to drive the variable-speed shaft of the paper machines, and two 75-hp motors will drive the constant-speed line-shaft of the same machines. Another 75-hp motor will operate other machinery in the mill. A 15-hp induction motor will be direct-connected to a triplex pump, one of 10 hp will drive the wet machines, a 20-hp motor will drive the agitators for the clay-mixing tanks, and a 30-hp motor will drive the conveyors. The order to the Westinghouse Electric and Manufacturing Company also includes a 560-kw revolving field alternator, designed to be direct-connected to a water wheel, with the exciter, switchboard and instruments to accompany the generator. The engineer and designer of the Sturgeon Falls plant is Mr. George F. Hardy.

OMAHA TROLLEY EXTENSIONS.—The Seligman banking house of New York, which recently purchased control of the Omaha street car lines, has announced the construction of 200 miles of suburban electric lines in Eastern Nebraska and Western Iowa. Incorporation papers were filed in Omaha recently under the name of the Omaha & Council Bluffs Street Railway Company, capital $15,000,000. The company also announces a ninety-nine-year lease of the Council Bluffs & Omaha Bridge & Motor Company, operating the Council Bluffs street car lines, and a bridge over the Missouri River between Omaha and Council Bluffs. The suburban lines will be in six directions from Omaha in Nebraska and in one direction in Iowa, but others are to be constructed in the latter State after those planned are completed. The company will also erect a $750,000 power plant in Omaha.

RICHMOND (VA.) TROLLEY DEAL.—Announcement is made that Frank J. Gould has obtained control of the Virginia Passenger & Power Company, which operates a traction system in Richmond, Va. The company has 122 miles of track in Richmond, Manchester and Petersburg, including an electric line twenty-two miles long between Manchester and Petersburg. The deal was consummated through the Merchants' Trust Company, of New York City, which is to be the fiscal agent and depositary of the company's funds. This company was organized last year under a special perpetual charter, combining six local companies in and around Richmond. The stock consists of $4,000,000 outstanding preferred, and $10,000,000 common. There are $6,000,000 of 5 per cent. mortgage bonds, and $7,000,000 underlying bonds, $2,000,000 of an issue of $15,000,000 remaining in the treasury. The balance, after interest payments from earnings for the quarter to November 1, was $95,000.

COPPER COATED CARS.—It is stated by the Metal Plated Car & Lumber Company, which was awarded the contract for sheathing 500 coaches with copper plate by the Interborough Rapid Transit Company, that it will require about 80 tons of copper to complete the work. The copper to be used on these cars was purchased about two months ago in anticipation of closing the contract from the Ansonia Copper Company. It is likely that the Rapid Transit Company will have at least 1,000 cars by the time the road is ready to be operated. In case the remaining 500 cars are to be finished in the same way, it would, of course, take 80 tons more to finish the work, making 160 tons consumed on the outside of Rapid Transit cars.

THE BROWNING MANUFACTURING COMPANY, Milwaukee, Wis., announce that it has established agents throughout the country to handle its motors. In the East it will be represented by the D'Olier Engineering Company, of New York, Philadelphia and Baltimore; the Western Electrical Supply Company, St. Louis, will represent it in the Southwest, and the Goudey-McLean Company, New York, will represent its foreign department. The selling arrangement which formerly existed with the Milwaukee Electric Company has been discontinued. The Browning motors have become widely known throughout the country and are in excellent demand.

ANOTHER JAPANESE ELECTRIC TRACTION PROJECT.—The construction of an electric traction system is contemplated in Osaka, the commercial capital of Japan, and a city of some 500,000 inhabitants. The Osaka Electric Light Company, which operates the second largest lighting plant in Japan (Tokio has the largest one), is said to be primarily interested in the project. The lighting plant is equipped with generators built by the General Electric Company. It is proposed to furnish power in the first instance to operate a 300-kw motor-generator. Twenty-four cars will be used as initial equipment. Each car will be fitted with two 25-hp motors.

BALL ENGINE ORDERS.—The Savoy Hotel, Kansas City, Mo., is installing an electric plant, consisting of 125-hp engine direct-connected to 75-kw General Electric generator; the Ball Engine Company, Erie, Pa., furnished the engine. The Glauber Brass Manufacturing Company, Cleveland, O., is installing an electric plant; the Ball Engine Company furnished a 175-hp engine. The Monument Pottery Company, Trenton, N. J., has recently installed an electric power plant consisting of 125 and 50 hp engines, direct-connected to Western Electric Company generators; the Ball Engine Company furnished the engines.

HUDSON RIVER POWER.—It is stated that the Hudson River Water Power Company and the Hudson River Electric Company, jointly, have made a 15-year contract with the electric light company at Albany to supply it with 8,000 hp, and with the electric light company of Troy to supply it with 6,000 hp at a price which will net about $60 per hp per year. This 14,000 hp is to be used for electric lighting. The Hudson River companies are also to deliver to the Albany and Troy companies, for power purpose, 3,000 and 5,000 hp respectively at a price which will net the Hudson River companies $96 per hp per annum.

NEW GERMAN WORK.—The Schlesischen, Kohlen & Kokswerke, in Fellhammer (Schlesien) Germany, contemplate installing a new electric power station, the total cost of which is to be 1,750,000 marks. In the following cities in Germany the municipalities have just passed upon the erection of electric power plants: Habelschwerdt, Reg. Bez. Breslau; Kostritz (Reuss J. L.); Rheinberg (Rheinpreussen); Steinheim (Westfalen). For further information address the Stadtverwaltung of the different cities. In Swinemunde the municipality is contemplating the building of an electric street railway.

FIRE ALARM CONTRACT.—The New York Central Railroad Company has made a contract with the Gamewell Fire Alarm Telegraph Company for the installation of fire alarm systems for the piers, buildings and premises of the company at Sixtieth Street, New York City, and at Weehawken, N. J. It is a pity that something cannot be done to renew the antiquated and obsolete fire alarm boxes of the New York City Fire Department. Commissioner Greene, of the Police Department, has made public a proposal to adopt an extensive police patrol signal system.

BROOKLYN UNDERGROUND CONTRACTS.—Mr. G. M. Gest, the conduit contractor, has been awarded additional contracts for placing underground the remainder of the overhead system of the Brooklyn Heights Railroad Company, Brooklyn, N. Y., which is being done on account of the recent order of Commissioner Robert G. Monroe. This will practically complete the removal of the overhead system of that company within the prescribed area, and work will be finished early in the spring. These contracts amount to nearly $40,000.

BIG OFFER FOR MEXICO CITY TRACTION SYSTEM.—The Mexico Electric Tramways Limited, of London, which is practically controlled by the Anglo-African house of Wernher, Beit & Company, is said to have refused an offer of no less than $18,000,000 for its properties and concessions. The authorized capital of the concern is $10,000,000, but the stock issued amounts to only $5,000,000. The road operates over 600 American cars. These figures represent Mexican money.

BOILERS FOR JAPANESE PLANT.—The Hakata Electric Company, of Hakata, Island of Kuishi, Japan, particulars of whose new American electrical equipment were given in our last issue, will have installed in its plant two 250-hp Cahall horizontal boilers, manufactured by the Aultman & Taylor Manufacturing Company, of Mansfield, O. These boilers will displace the Japanese ones now in use. The contract was secured through Bagnall & Hilles, Yokohama.

LIGHTING CONCESSION FOR RANGOON.—The municipality of Rangoon is expected to invite applications shortly for the granting of a concession to light electrically that Burmese city. The franchise is to be offered for a period of 42 years, after which time the local authorities will reserve the privilege of purchasing the property. Provision will also be made for the construction of an electric traction system.

STEEL FOR YOUNGSTOWN, O., PLANT.—The American Bridge Company, of New York, 100 Broadway, has secured the contract for the new engine house which the Youngstown-Sharon Railway & Light Company, 46 Wall Street, is having built at Youngstown, O. The company's plant is being enlarged from 2,400 hp to 4,500 hp. Sanderson & Porter, Bank of Commerce Building, New York, are the consulting experts.

MOTORS IN BROOKLYN.—In its Bulletin for December, 1902, the Edison Electric Illuminating Company gives the following interesting exhibit of the growth in horse power of motors connected to its circuits: 1891, 156 hp; 1892, 403 hp; 1893, 1,042 hp; 1894, 1,424 hp; 1895, 1,884 hp; 1896, 2,532 hp; 1897, 3,146 hp; 1898, 3,759 hp; 1899, 4,425 hp; 1900, 5,809 hp; 1901, 7,864 hp; 1902, 12,734 hp; Dec. 1, 1902, 14,052 hp.

COAL FROM ENGLAND.—The Philadelphia Rapid Transit Company has closed a contract for 20,000 tons of Welsh and Northumberland coal, because of inability to secure prompt delivery of Pennsylvania anthracite and has chartered several steamers to bring it over. This is rather amusing, not to say startling, when one remembers that Philadelphia is largely a creation of the Pennsylvania coal fields.

ADDITIONAL EQUIPMENT FOR POWER PLANT.—The Worcester and Connecticut Eastern Railway Company, of Danielson, Conn., has contracted for the supply of an additional Westinghouse generator of 400-kw capacity. The company's plant is operated by water power. The generator will be belted to a turbine built by the Holyoke (Mass.) Machine Company.

S. D. WARREN & COMPANY have recently bought three induction motors, two of 100 hp and one of 150 hp, from the Westinghouse Electric and Manufacturing Company, to be installed in their paper mill at Cumberland Mills, Me. The two 100-hp motors will be used for driving blowers furnishing mechanical draft, and the 150-hp motor will drive papermaking machinery of various kinds.

EQUIPMENT FOR MANILA PRINTING PLANT.—The National Electrical Supply Company, of Washington, D. C., is letting considerable contracts for various equipments to be installed in the United States Bureau of Public Printing, Manila. The Crane Company, of Chicago, has been allotted a substantial order for its specialties.

PUMPS FOR JAPAN.—The Nagaoka Kogio Kaisha, Japan, has ordered through Takata & Company two oil-pressure pumps, to be built by the International Pump Company. One will be a 10-in. x 2½-in. x 10-in. Worthington. The other will be a 12-in. x 3-in. x 12-in., of Snow build. Both pumps are to be horizontal duplex.

WESTINGHOUSE EQUIPMENT FOR BATAVIA, N. Y.—The electrical engineering and contracting firm of Sanderson & Porter, New York, has let contracts on behalf of the Consolidated Gas & Electric Company, of Batavia, N. Y., for three 150-kw Westinghouse generators for direct connection to 260-hp Westinghouse gas engines.

G. E. MOTORS IN JAPAN.—The General Electric Company will furnish the motors for the sixteen trains to be operated on the new Kobu high-speed electric road, which will run in the vicinity of Tokio, Japan. Each train will be composed of three cars. The motors will aggregate 200 hp per train.

GERMAN PROPOSALS WANTED.—The firm of Louis Walter & Co., manufacturers of electric light and power supplies, in Cologne, Germany, wish proposals for motor-driven machinery and apparatus for all kinds of industrial machinery, also the latest devices for light and power generation purposes.

General News.

THE TELEPHONE.

LOS ANGELES, CALIF.—The United States Long Distance Telephone Company, organized some time ago in Washington, D. C., with a capital stock of $200,000,000, proposes to cover Southern California with its wires, and as an initial step in the enterprise has made application for a blanket franchise from the Board of Supervisors to do business throughout Los Angeles County. As an evidence of its good faith the company offers to obligate itself in the franchise asked for to expend $40,000 in four years.

ALAMOSA, COL.—The Colorado Telephone Company is preparing for extensive improvements in the San Luis valley the coming year. The company has over 100 telephones working in Alamosa, besides as many more in the smaller towns of the valley. The company purchased all the telephone lines in the southern part of the valley and is trying to buy the lines in the northern part. The company has plans to extend its lines from Alamosa to Creede, Pagosa Springs and Durango, also south into the Red River country in New Mexico.

AMERICUS, GA.—The Bell Telephone Company has been enjoined by farmers from running its long distance lines across farms between here and Savannah. The Bell Company will soon have lines running in every direction from Americus.

KLONDIKE, ILL.—The Montmorenci Telephone Company will build ten more miles of line as soon as the weather will permit.

LAKE PARK, IA.—The Midland Telephone Company will build a telephone exchange at this place.

ELDRIDGE, IA.—The Eldridge Mutual Telephone Company, capital $10,000, has been incorporated. Mr. Jas. H. Wise is president.

CAMBRIDGE, IA.—The Cambridge Independent Telephone Company has incorporated, with a capital stock of $10,000, by Frank Thompson and others.

DELPHI, IND.—The Yoeman Co-operative Telephone Company has applied for a franchise at this place.

CORYDON, IND.—The Eureka Telephone Company is extending its system in this section and is building lines in Boone, Heth, Washington, Posey and Taylor townships. A new exchange is to be established at Corydon.

EVANSVILLE, IND.—City Attorney Funkhouser says the litigation between the city and the Cumberland Telephone Company will in no way interfere or delay the work of installing a municipal telephone system in this city. He and Mayor Covert have just returned from Chicago and say they succeeded beyond expectation in interesting supply men.

BLUFFTON, IND.—The United Telephone Company, of Indiana, has decided to issue bonds to the amount of $500,000 and of this amount to use $100,000 to take up indebtedness of the plant. Four hundred thousand dollars will be used for extensions and repairs. The company has plants at Marion, Huntington, Hartford City, Montpelier and Bluffton. The company held its annual meeting at Bluffton on Dec. 23, when the plans of operations were discussed and agreed upon. Hon. Hugh Dougherty is president of the company.

INDIANAPOLIS, IND.—The New Telephone Company, of this city, claims to have broken the record, on Christmas eve, in the number of messages handled in the main exchange. During the day there were put through 83,794 calls. During the hour between 4 and 5 o'clock P. M. there were put through 8,266 calls. This work was done by 38 operators and was an average of 217 calls an operator. During that busy hour the operator having the highest number made 433 connections, an average of 7.2 per minute.

FT. WAYNE, IND.—The Gas Belt Construction Company, composed of Ft. Wayne telephone capitalists has been in existence for less than a year, but the stockholders received a 10 per cent. dividend as a Christmas present. The company will turn over the Muncie and Alexandria independent telephone exchanges on New Years' Day to their local owners. Another contract has been taken for the construction of an exchange at Eaton and for stringing of a new metallic circuit on the toll lines connecting the principal cities of the gas belt. The profits of the toll lines in some cases have reached 50 per cent.

INDIANAPOLIS, IND.—The Central Union Telephone Company has placed a new switchboard in the private telephone exchange of the Indianapolis *News*. The switchboard is for use only at branch exchanges where there are five or more trunks and twenty or more stations connected with same. This is a great improvement in private exchange switchboards over those formerly in use and much more simple. Figures are always interesting and often suprising. For instance, a comparison with directories just issued by the two telephone companies doing business in this city, the Central Union shows about 7,200 subscribers and the New Company 6,000 subscribers, making a sum total of 13,200 for both companies. A careful investigation reveals that only about 13 per cent. subscribe to both services or only 1,716 subscribers of the total number have both, leaving 11,484 who have no communication with each other.

AUBURN, KY.—Farmers of Stowers and Auburn have organized a telephone company and will build lines connecting both towns with an exchange at Auburn.

BOWLING GREEN, KY.—The Bowling Green Telephone Company has placed a contract with the Stromberg-Carlson Company for its switchboard and telephones. The exchange will be completed as soon as possible.

NEW ORLEANS, LA.—About 3,500 miles of telephone wire have been strung on the Illinois Central Railroad leaving only 200 miles yet to be built.

LITCHFIELD, MICH.—The Common Council has granted a franchise to a local company to establish a telephone exchange in the village.

BAY CITY, MICH.—Articles of incorporation of the Northeastern Telephone and Telegraph Company, of Bay City, have been filed. The capital stock is $100,000, all subscribed, of which $30,000 is paid in. The board of directors consists of George E. Dutton, Saginaw; James F. Land, Detroit; Wm. W. Jones, Toledo; O'Brien O'Donnell, Toledo; Thomas F. Hancock, Detroit.

GRAND RAPIDS, MICH.—President C. F. Root, of the Citizens' Telephone Company, announces that a contract has been placed with the Automatic Electric Company, of Chicago, whereby an automatic system will be installed and placed in operation by July 1, 1903. The improvements will cost about $150,000. The new board will have a capacity of 12,000 lines.

KANSAS CITY, MO.—The Kansas City Home Telephone Company, of Kansas City, has increased its capital stock from $50,000 to $3,000,000.

HENDERSONVILLE, N. C.—The Asheville, N. C., Telephone Company is rebuilding the plant at Hendersonville. A new switchboard is being installed by the Stromberg-Carlson Company.

FAYETTEVILLE, N. C.—The American Long Distance Telephone Company, which is to build a line between Petersburg, Va., and Cheraw, S. C., has been granted a franchise to install a long distance station here.

FARGO, N. D.—The Twin City Telephone Company has applied for a franchise in this city.

EAST ORANGE, N. J.—The New York and New Jersey Telephone Company has awarded the contract for an office building in this city to cost $58,600.

MOUNT VERNON, N. Y.—John D. Rockefeller and Miss Helen Miller Gould remembered the telephone and telegraph operators at Irvington and Tarrytown on New Year's Day by sending them each a ten-dollar gold piece.

CLEVELAND, OHIO.—The Cleveland Telephone Company (Bell) is preparing to erect a modern branch exchange at Lakewood.

CINCINNATI, OHIO.—The City & Suburban Telephone Association paid its employees an extra months' salary as a Christmas present. During the past year the local business of the company has increased nearly 40 per cent.

NEWARK, OHIO.—The Central Union Telephone Company is installing one way party lines on a six months' trial at $1. The plan is being followed in other towns in the State where it is desirous of building up the system.

RELIEF, OHIO.—The Muskingum Valley Telephone Company has been incorporated with $5,000 capital stock by Amos Lawrence, W. M. Fisher, E. B. Vincent, T. W. Milner and W. W. Mason, all of Relief. It will build a system centering in that town.

TOLEDO, OHIO.—The Wheeling & Lake Erie Railroad is trying the experiment of installing telephones in its cabooses. Connection will be made with the telephone wires by means of an extension pole and it is believed the movements of trains will be greatly facilitated.

TOLEDO, OHIO.—The Toledo city authorities claim the United States Telephone Company is preparing to run its lines into the city without a franchise, in order to connect with the Toledo Home Telephone Company, and they have stationed police officers on the outskirts of the city to prevent the stringing of wires.

LORAIN, OHIO.—The Black River Telephone Company made a fine showing during the past year. It now has 900 telephones in operation, an increase of 200 during the year. It has orders for 300 more which will be installed as soon as the new Sterling board now under construction is completed. The new board has a capacity of 4,000 telephones.

CLEVELAND, OHIO.—It is understood on very good authority that the Cuyahoga Telephone Company is planning to increase its rates without asking the consent of the city. The officials of the company as well as prominent attorneys are of the opinion that the city has no right to dictate the prices a telephone company shall charge and that the contract between the city and company is void so far as this point is concerned. It is proposed to increase the residence rate from $36 to $44 and the business rate from $48 to $60. It is also proposed to furnish four-party line service in residences at $18. It is believed that if these charges can be made, the business will increase materially and the property placed in good financial condition.

CLEVELAND, OHIO.—It is reported in financial circles that Henry A. Everett will personally purchase from the Federal Telephone Company a corretrolling interest in the United States Telephone Company and will devote his attention toward making this the greatest independent system in the country. It is also stated that Maxime Reber, at present general manager of the company, will become president. Despite the fact the United States Telephone Company has spent very little in improvements during the past year, the earnings are showing a good increase and on the October earnings as a basis it is paying all fixed charges and earning 3 per cent. on the outstanding stock. With contemplated improvements, the property will be placed on a fine earning basis.

STOUT, OKLA.—The Stout Rural Telephone Company, capital $10,000, has been incorporated by W. B., S. M. and George Aurier, and others.

TRENTON, S. C.—A corps of surveyors is near here to locate a long distance telephone line to Augusta. The line may be extended to Columbia, S. C.

WALHALLA, S. C.—The Oconee Telephone Company has been granted a charter with a capital stock of $10,000. The officers are W. J. Stribling president and treasurer, and W. R. Dongle, secretary.

CHATTANOOGA, TENN.—The committee on granting a franchise to Mrs. Annie McElroy Brett will report favorably upon granting a telephone franchise for 21 years, Mrs. Brett agreeing that the franchise shall become void if $300,000 is not spent within one year, the work to be started within six months, and 2,000 subscribers to be secured.

RICHMOND, VA.—The Richmond Telephone Company has begun putting its wires underground; $250,000 will be expended in the work.

BETHANY, W. VA.—The West Penn Telephone Company, which had an exchange here, will discontinue the service as there are not enough subscribers.

GREEN BAY, WIS.—The Valley and Telegraph Company, of Green Bay, has been incorporated, capital stock $200,000. Incorporators: William Joannes, J. S. Van Nortwick and Jules Parmentier.

ELECTRIC LIGHT AND POWER.

CLAREMONT, CALIF.—Articles of incorporation have been filed by the Citizens' Light and Water Company, of Claremont; capital stock, $75,000. Directors: L. T. Gillet, G. A. Gates, C. C. Johnson, E. C. Norton and L. N. Smith, all of Claremont.

HARTFORD, CONN.—The Hartford Electric Light Company will build a five-story building adjacent to its present plant on Pearl Street.

VALDOSTA, GA.—The Valdosta Electric Light plant is to pass into the ownership of the Westinghouse interests. It is stated that $125,000 will be invested by the new owners.

MILLEDGEVILLE, GA.—The fine water power at Furman's Shoals on the Oconee River will probably be developed soon. Litigations have checked the development, but the question of ownership has been settled recently and the company's plans will be announced in the near future.

BRUNSWICK, GA.—The plant of the Brunswick Light and Water Company has passed into the hands of the Mutual Light and Water Company. The former concern has been in the hands of a receiver, Maj. W. S. Greene. Albert Fendig will be manager of the Mutual Company. He has been elected president of the concern. Major Greene has also been named as receiver for the Columbus Light and Water Company, of Columbus, Ga.

CLINTON, ME.—The Clinton Electric Light & Power Company, of Clinton, has been incorporated with a capital of $10,000. President, F. L. Besse; treasurer, Manby Morrison, both of Clinton, Me.

LANSING, MICH.—The Lapeer Light & Power Company, of Lapeer, has been incorporated with $30,000 capital stock.

CORRY, MICH.—The Corry Electric Lighting Company has notified its patrons that on account of being unable to secure coal, it will be compelled to abandon its incandescent service in order to keep the city lights burning.

KALAMAZOO, MICH.—The large new dam of the Kalamazoo Valley Electrical Company at Plainwell was put into service on Dec. 23 in the presence of a large assemblage. The dam has a capacity of 1,600-hp and the six turbine wheels furnish electrical power for the lines of the Michigan Traction Company in Kalamazoo, the Interurban line between here and Battle Creek and many manufacturing plants in this section of Michigan.

ASHEVILLE, N. C.—The W. T. Weaver Power Company proposes to furnish the city with electric power from a plant now being built on the French Broad River where a minimum of 3,000-hp is available. It is expected to have the plant in operation by July 1, 1903.

BUFFALO, N. Y.—The city hall trustees have asked for an appropriation of $45,000 for the installation of an electric light plant.

SARATOGA, N. Y.—The Hudson River Water Power Company's stockholders have voted to increase the capital stock from $2,000,000 to $5,000,000.

MIDDLETOWN, N. Y.—The National Consolidated Company, which plans to supply gas and electric light and power to Middletown, Goshen, Port Jervis, Huguenot, Cuddebackville, Otisville, Monticello, Fallsburg, Liberty and Jeffersonville, in Orange and Sullivan Counties has been incorporated with a capital of $50,000. The directors are C. M. Priggen and G. R. Larwill, of Brooklyn, and Henry Floy, of New York.

PROSPECT, OHIO.—The Prospect Electric Light Company is installing new equipment.

PERRYSBURG, OHIO.—The Witzler Electric Light Company has been incorporated with $10,000 capital stock by C. F. Chapman, Frank W. Laughling, Wm. B. Duck, George C. Weller and Raymond Hartshorn. The company will build a lighting plant at Perrysburg.

GEORGETOWN, OHIO.—The Cincinnati, Georgetown & Portsmouth Railway has submitted a proposition to furnish current to the village for electric lighting and an engineer is to be employed to furnish estimates on the cost of erecting poles, installing wire and arc lamps. If the figure is right the proposition will be accepted.

HARRISON, OHIO.—The citizens of Harrison are considering a proposition to purchase the lighting plant owned by J. A. Graft of that place. The town is directly on the State line, the portion known as West Harrison being in Indiana. The citizens of the Indiana town have declined to pay the rates demanded by Mr. Graft.

PITTSBURG, PA.—The Manufacturers' Light & Heat Company has increased its capital stock from $5,000,000 to $10,000,000.

PITTSBURG, PA.—In the Folsom district, Wetzel County, W. Va., the South Penn. Oil Company is erecting an electric power plant for operating its pumping and drilling wells. The plant, when completed, will cost about $200,000 and if it proves a success will be enlarged to several times its initial capacity.

LEWISBURG, TENN.—The town has voted $5,000 electric light bonds for building an electric light plant.

LYNNVILLE, TENN.—The citizens of Lynnville are considering the proposition to build an electric light plant.

CHATTANOOGA, TENN.—The board of public works will ask that $115,000 be included in the proposed bond issue for municipal lighting. There is some opposition to the present lighting service.

CHATTANOOGA, TENN.—The Chattanooga Light and Power Company has begun a large addition to its plant which together with new machinery purchased represents an investment of about $200,000.

KAUFMAN, TEX.—The Kaufman Electric Light Company, of Kaufman, capital stock $25,000, has been incorporated by M. A. Joy, G. E. Nolle, Terrell, and W. S. Catlin, Kaufman.

RACINE, WIS.—W. J. Hayes & Sons, Cleveland bankers, have submitted a proposition for the purchase of the Racine municipal electric lighting plant and water works. The matter is under consideration.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has put in operation a second electric railway to Ensley. The capacity of the power plant is also being doubled.

MACON, GA.—The Macon Railway and Light Company has executed a mortgage for $1,000,000 to the North American Trust Company, of New York, as trustees, on all of its properties. This will perfect the consolidation of the street railways. The bonds run for 50 years and are 5 per cent. gold coupons.

NEW ALBANY, IND.—The council has granted a new franchise to the New Albany Street Railway Company, giving it the right to carry freight, baggage, express and mail.

LOGANSPORT, IND.—The Wabash Traction Company has completed its line between Wabash and this city and trial trips have been made. Charles W. Blakeslee, of New Haven, Conn., is the principal owner.

TERRE HAUTE, IND.—The Indianapolis & Plainfield Traction Company is about to complete arrangements for the extension of its line to the west, the plan being to reach Indianapolis by connecting with the Terre Haute & Knightstown Railway.

AURORA, IND.—The Indiana Southern Electric Railway Company has been incorporated and will build a line from this city to Rising Sun. August Herman, the Cincinnati capitalist, is interested in financing the road and is one of the directors. The original capital is $10,000.

TERRE HAUTE, IND.—An electric line is to be constructed between this city and Clinton. The plans have been made and the project financed by the Stone & Webster Company, of Boston. Gardner E. Wells has charge of the construction and is preparing to build the line at once.

LAPORTE, IND.—A company has been formed and articles of incorporation are ready to file which will promote the building of an electric railway to connect Laporte with Logansport, and which further contemplates building a branch line from Bass Lake via Lake Maxinkuckee, to Rochester.

INDIANAPOLIS, IND.—The Indianapolis, Lebanon & Frankfort Traction Company has filed a notice changing its title to the Indianapolis & Northwestern Traction Company and increasing its capital stock from $25,000 to $2,500,000. The line will extend to Lebanon and is being constructed to Frankfort and Lafayette.

WABASH, IND.—The survey of the Wabash and Rochester trolley line, under the direction of P. A. Tuttle, president of the company, has been completed. The line is 35 miles long. Work is to begin as soon as the weather permits and the line is to be completed and in operation by September. T. W. Latham, of Cleveland, Ohio, is secretary of the company.

FT. WAYNE, IND.—General Manager Nelson, of the Ft. Wayne & Southwestern Traction Company, announces that his people have succeeded in financing the Ft. Wayne & Southern Railway from Huntington to Warren, with two branches from Warren, one to Montpelier and the other to Marion. With the completion of this line and branches, the system will have about sixty miles of track.

SOUTH McALESTER, I. T.—Articles of incorporation have been filed by the Purcell and Lexington Street Railway. The authorized capitalization is $100,000. The articles state that the object is to build and operate an electric street railway between Purcell, I. T., and Lexington, Okla. William T. James, Thomas C. Woods and J. F. Sharp are the incorporators.

DETROIT, MICH.—The Detroit United Railway paid its regular quarterly dividend of 1 per cent. on Jan. 3.

CITY OF MEXICO, MEX.—The electric street railway company in the City of Mexico is considering the project of building an electric road to the town of Texcoco, a distance of about eighteen miles.

ALBANY, N. Y.—A certificate of consolidation of the Fonda, Johnstown & Gloversville Railroad Company, the Amsterdam Street Railroad Company and the Cayadutta Electric Railroad Company, under the title of the Fonda, Johnstown & Gloversville Railroad Company, has been filed. The capital is $1,950,000, and the officers and directors are: J. L. Hees, Fonda, president; Gustave Levor, Gloversville, first vice-president; J. C. Ferris, Johnstown, second vice-president; G. M. Place, Gloversville, secretary and treasurer.

CELINA, OHIO.—J. W. Loree, representing Muncie and Portland people, has applied for a railway franchise in this town.

MARION, OHIO.—The Columbus, Delaware & Marion Railway Company will be extended from Marion to Bucyrus, by way of Caledonia. The company is installing a large direct-connected unit in its station at Stratford. It will more than double the capacity of the plant.

CAMBRIDGE, OHIO.—The Consolidated Street Railway Company, of Cambridge, has been granted a franchise to extend its line through Byesville.

GREENVILLE, OHIO.—The Greenville, Bradford & Covington Electric Railway Company has been incorporated to build a line from Greenville to Covington, by way of Bradford.

SANDUSKY, OHIO.—Negotiations are pending for the merging of interests of the Sandusky, Clyde, Tiffin & Southern Railway with those of the new Sandusky Southwestern Traction Company.

CINCINNATI, OHIO.—The Board of Public Service has adopted a resolution requiring the Cincinnati Traction Company to relay tracks and operate cars on the old cable line on Sycamore Street.

MARIETTA, OHIO.—There is talk of extending the Parkersburg & Marietta line northward following the Ohio side of the river as far as Fly and then crossing to Sistersville, W. Va. This would connect with the line being built from Middlebourne to Sistersville.

ZANESVILLE, OHIO.—The Appleyard syndicate has acquired control of the Bellaire, Zanesville and Cincinnati Railroad and will standardize its gauge and change it to an electric interurban line. The Ohio River and Western Railway Company will be the new name of the corporation.

GRANVILLE, OHIO.—The Newark & Granville Street Railway has secured a new 25-year franchise in Granville. The road is owned by the Columbus, Buckeye Lake & Newark Traction Company.

DELAWARE, OHIO.—W. G. Hale, representing Chicago capitalists, has applied for a franchise to cross county highways between Marion and Forest by way of Marseilles. Private right of way is being purchased.

GALLIPOLIS, OHIO.—A company has been organized to connect Chambersburg with Raccoon Island, in the Ohio River. Ernest Riggs is secretary of the company. An effort will be made to secure entrance to Gallipolis.

NEWARK, OHIO.—The Columbus, Buckeye Lake & Newark Traction Company is surveying a new route for its extension from Newark to Zanesville. The company had difficulty in securing right of way over the route originally laid out.

GALION, OHIO.—The Ohio Central Traction Company will shortly install a new generator which will be direct-connected to a DeLaval steam turbine. The additional unit will give the company a total of 10,000-hp. at its Galion station.

ZANESVILLE, OHIO.—The Zanesville Railway, Light & Power Company has completed plans and closed some of the contracts for its new power station. The building will be of brick, 130 x 72 feet, and it will have a capacity of 4,000 horse power.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is placing gongs on the rear platforms of a number of its cars. The gong is operated by the motorman and warns passengers stepping from the car that another car is approaching from the opposite direction.

DAYTON, OHIO.—Dayton is to have another interurban line to be known as the Dayton & Camden Railway. The proposed route is over the Dayton Pike to Bowerstown, Germantown, Mudlick, Winchester and Camden. J. Borris and Peter Grubbs, of Dayton, are the promotors.

KENTON, OHIO.—The Appleyard syndicate which is building the Urbana, Bellefontaine & Northern Railway has applied for a franchise through Kenton. The syndicate announces that the line will be extended northward to connect with Toledo, affording a new Cincinnati-Toledo line.

HAMILTON, OHIO.—The Cincinnati, Dayton & Toledo Traction Company has voluntarily increased the wages of motormen and conductors. The advance takes the form of a sliding scale, with a minimum of 16 cents and a maximum of 19 cents for city lines, and 19 to 23 cents per hour on interurban cars.

CLEVELAND, OHIO.—The Washington, Baltimore & Annapolis Railway, which has its headquarters in this city, has purchased a site at Annapolis for car house and machine shop, and another at East Hyattsville, Md., for its main power house. The road is being built and equipped by the Cleveland Construction Company.

BARBERTON, OHIO.—Ladies of this town have instituted a unique crusade. They complain that laborers from the numerous potteries are so covered with dust that it soils dresses to sit near them, and they have requested the Northern Traction Company to provide brushes on the platforms and oblige the men to brush their clothes before entering the car.

SPRINGFIELD, OHIO.—The syndicate headed by Ex-Gov. Asa Bushnell has formed a construction company to be known as the Champion Construction Company. which will build the various lines promoted by the syndicate. The first roads to be built will be from Springfield to Washington, C. H., and from Springfield, Troy, Sidney and Piqua. Grading on these lines will start at once.

COLUMBUS, OHIO.—The Cincinnati, Dayton & Ft. Wayne Railway Company, of Dayton, has been incorporated with $1,000,000 by S. F. George, C. W. Gebbart, B. B. Levy, J. E. Welliver and G. F. Giel. The company proposes to construct a line from Cincinnati to Ft. Wayne with a branch line to Toledo. The company was originally incorporated under the laws of South Dakota and it has secured considerable right of way.

CLEVELAND, OHIO.—The Lake Shore Traction Company has been incorporated by Cleveland people who propose to build a line from Buffalo to Dunkirk, N. Y. The company will have a capital stock of $2,000,000, with a bond issue of the same amount. At a meeting held in Buffalo the following officers were elected; J. W. Holcomb, Cleveland, president; Fred Green, Fredonia, N. Y., treasurer; Clarence Bushnell, Buffalo, secretary. The above, with Luther Allen and Jay Latimer, Cleveland, are directors.

TOLEDO, OHIO.—The Toledo, Port Clinton & Lakeside Railway Company has been incorporated, with $10,000 capital stock, by H. R. Klauser, P. McRory, L. E. Flory, H. S. Landis and D. H. James. It is proposed to build a line along the lake shore from Toledo through Millbury, Elmore, Oakharbor and Port Clinton to Lakeside. Officers have been elected as follows: P. McCrory, president; L. E. Flory, vice-presidentt; D. H. James, secretary, and H. R. Klauser, treasurer. The above, with A. E. Klauser, P. Landis, are directors.

AKRON, OHIO.—It is stated that at the annual meeting of the Northern Ohio Traction Company a proposition will be proposed for the repurchase of the Canton-Akron Railway. This road was purchased by the company about a year ago after a large sum had been spent in right of way and grading. At the time of the Everett-Moore trouble the Canton-Akron road was taken over by the Tucker-Anthony syndicate, of Boston. That there are close relations between the two companies is evidenced by the fact that an arrangement has been effected whereby round trip tickets are now sold clear through from Massillon and Canton to Cleveland.

CLEVELAND, OHIO.—The officials of the "Union Traction Company," which some months ago fitted up palatial offices in the Williamson Building, this city, are missing and a lot of creditors are anxious to learn their whereabouts. The company advertised freely for clerks, stenographers, bookkeepers, conductors, motormen, etc., and when replies were received the applicants were told they would have to buy stock in the company. Motormen and conductors were promised 23½ cents an hour and were to be given employment "after cars began to run between Saginaw and Flint, Michigan." For the past month there has been no one in the offices. Recently a furniture company, which furnished the offices, attached the furniture, but the agent of the building declined to permit the constable to use the freight elevator, as the building had an account against the traction company for office rent. The constable carried his point by hiring several laborers and carrying the goods down twelve flights of stairs.

LAWTON, OKLA.—The Lawton & Craterville Electric Railway Company, capital stock $500,000, has been incorporated by L. W. Brewer, C. F. Smith, J. E. Williams, A. L. Quint, J. R. Lewis, J L. Wiggins, G. A. Horton, P. T. Benbow, W. M. Turner, M. M. Holmes, J. S. West, J. W. Martin and F. M. Robinson.

OTTAWA, ONT.—It is stated that a charter will be asked for an electric railway, in New Ontario, to run between Lac Seul and the Mikado mine, and to develop and transmit electric power. The road will pass through Keewatin, Norman and Rat Portage. A feature of the project new to electric railway promotion is that the promoters say they will place a stated number of settlers in the country opened up.

OTTAWA, ONT.—Toronto and Pittsburg, Pa., capitalists propose building a belt electric line through the most interesting part of the Niagara peninsula. The route is to be from Homer to Niagara-on-the-Lake, thence along the river road to Queenston. Messrs. Frank Broderick and Herbert L. Dunn, of Toronto, Ont., and H. L. Christy, of Pittsburg, Pa., are the gentlemen promoting the scheme. Work is to be commenced next spring and completed by July 1, 1905.

CLARKSVILLE, TENN.—The promoters of the Nashville-Clarksville Electric Railway announce that right of way having been secured, they will begin work on the line in the early spring.

WHEELING, W. VA.—The Wheeling Traction Company is planning to make important improvements to its power equipment and rolling stock.

MORGANTOWN, W. VA.—The Morgantown Electric & Traction Company has awarded contracts for the construction of its system. Contracts for rails were let to the Lorain Steel Company and the Cambria Steel Company while the Westinghouse, Church, Kerr & Company and the Westinghouse Electric & Manufacturing Company have been awarded contracts for the electrical equipment. About four miles of track will be built in the city and 13 cars will be operated at the start. The power station will be equipped with two 200-kw 600-volt engine type railway generators, two 2,200-volt, two-phase alternating-current generators, two 325-hp Westinghouse engines, two 280-hp Westinghouse engines and three 310-hp Sterling water tube boilers. The capital stock of the company is $200,000, and bonds to the amount of $300,000 have been authorized. Officers of the company are I. C. White, president; J. McDermott, vice-president; Frank Cox, secretary; E. M. Grant, treasurer; George H. Switzer, superintendent and electrician, and W. S. Webb, engineer.

NEW INDUSTRIAL COMPANIES.

THE DEL COOBE ELECTRIC COMPANY, of Wilmington, Del., has been incorporated with a capital of $1,500,000.

THE ELECTRIC MINING & MILLING COMPANY has been incorporated at Salt Lake City, Utah, with a capital of $300,000.

THE MOTOR CAR COMPANY OF NEW JERSEY, Newark, N. J., with an authorized capital of $50,000, has been incorporated by Inglis M. Uppercut, Richard T. Newton and C. V. Childs.

THE KIMMEY ELECTRIC LIGHT DISPLAY COMPANY, of Jersey City, with an authorized capital of $1,000,000, has been incorporated by John Kimmey, Ives Horton, Charles A. Stader.

THE AMERICAN ELEVATOR COMPANY, of New York, has been incorporated with a capital of $25,000. Directors: Thomas D. Hewitt, Andrew Woelfee and Sidney L. Josephthal, New York.

THE AMERICAN PUBLIC UTILITIES COMPANY, of Cincinnati, Ohio, has been incorporated to build, own, operate and maintain electric light and gas works and heating apparatus. Capital, $2,000,000.

W. R. OSTRANDER & COMPANY, of New York, has been incorporated, capital $150,000. Directors: J. W. Purdy, Jr., W. H. Roberts, C. P. Lashell and I. A. Terrill, of New York, and H. E. Monk, of Flushing, L. I.

THE DIXON ELECTRICAL COMPANY, LTD., has been organized under the laws of Michigan and will establish a factory in Toledo. L. P. Dixon and O. S. Brumback are interested. The company will do a jobbing business in dynamos, motors and electrical supplies and will also manufacture new and improved lamp sockets, the invention of Mr. Dixon. At present the company is located in the Scott Building, but it will build a new factory next spring.

THE BROSNAN ENGINEERING AND CONSTRUCTION COMPANY, of Worcester County, Md., has been incorporated at Snow Hill, Md., with a capital stock of $500,000. The incorporators are J. M. Brosnan, of New York City; E. Caldwell, Thos. Edwards and Chas. B. Cook, of Baltimore, and Wm. Adams, of New York. The object of the company is to construct and sell electric railways, telegraph, telephone lines, etc.

OBITUARY.

CAPT. OLIVER ELDREDGE, vice-president of the Stockton, Cal., Gas & Electric Company, died in San Francisco on December 16. He was born at Yarmouth, Mass., in 1818, and was for a long time engaged in maritime work. Later he took up mercantile affairs on shore and became interested in gas and electricity.

PERSONAL.

MR. EDWARD L. LEEDS, of London, England, manager of the European business of the Brown Hoisting Machinery Company, of Cleveland, Ohio, is now on a short visit to this side in relation to some important contracts pending across the Atlantic.

MR. G. MARCONI.—It is stated from Rome, which is a rather roundabout way, that Mr. Marconi, during his recent residence at Bologna, while pursuing his electrical researches, discovered almost accidentally a means of getting pure oxygen from the air at a trifling expense.

MR. R. M. BARWISE, formerly active in the bicycle and automobile field, but latterly connected with electrical interests in Philadelphia, has taken charge of the branch office in that city of the Buckeye Electric Company of Cleveland, with which he has already been associated.

MR. T. A. EDISON interviewed as to problems for 1903 says they are: "Fighting bacteria, getting electricity direct from coal and power from the elements and applying to manufactures the many uses of electricity." He is to have his storage battery ready early this year.

MR. MYRON T. HERRICK, the Cleveland banker, prominent in electric light and electric railway development, is mentioned as a likely presidential candidate, as well as a very probable nominee for Governor of Ohio as a step in that direction. He was a warm personal friend of President McKinley.

MR. JOHN BOTTOMLEY, the well-known New York lawyer, who is also a nephew of Lord and Lady Kelvin, exchanged Christmas and New Year greetings with them in Scotland by means of the Marconi wireless system, to and from Glace Bay. Mr. Bottomley is now prominently connected with the American Marconi interests.

MR. E. R. WEEKS, past president of the National Electric Light Association, and now a member of the firm of Weeks, Kendall & Newkirk, consulting engineers, of Kansas City, Mo., has been visiting the East, renewing old acquaintanceships and calling on old friends. He is greatly interested in the latest developments of the central station art.

MR. F. F. SAPP and Mr. R. Hendrickson, of the North Electric Company, of Cleveland, Ohio, have been visiting the East in the interests of the North telephone system and apparatus. A widespread report has been in circulation that Mr. Sapp, who is an old journalist, though still a young man, was going into the field of telephone journalism, but he states that there is no truth whatever in the rumor.

MR. E. J. PIETZCKER became associated December 1 with the Standard Underground Cable Company, with offices at 322 Rookery Building, Chicago. In a letter issued to the electrical field Mr. Pietzcker speaks of the new copper mill of the Standard Underground Cable Company as being one of the largest and most complete in the world. His former connection with the American Steel & Wire Company has given him a wide acquaintance throughout the electrical field.

MR. L. D. HILLES, of the American electrical firm of Bagnall & Hilles, Yokohama, is now on a long visit to the United States. Mr. Hilles has charge of the Singapore branch of the firm and also directs its interests in the Philippine Islands. He can be found at the offices of the New York Insulated Wire Company, 114 Liberty Street, at which place as already mentioned in these columns Mr. A. L. Bagnall is making his headquarters while in this city. Mr. Bagnall expects to sail for Japan within the next week or ten days, but Mr. Mr. Hilles may remain in America for three months or so.

MR. HENRY H. HUMPHREY.—At the annual meeting of the Engineers' Club of St. Louis the annual prize, consisting of $50 in gold and an engraved certificate, was awarded by the executive committee to Henry H. Humphrey, for the best paper presented to the club during the past year. The subject of this paper, which will be printed in the Journal of the Association of Engineering Societies, was "On the Use of Beaumont Oil as Fuel." Mr. Humphrey is the consulting electrical and mechanical engineer of St. Louis, who established more than a local reputation by designing during 1901 a complete power plant of 1,500-hp. for the DeBeers Explosive Works at Cape Town, Africa.

DR. S. S. WHEELER, chairman of the technical committee of the Automobile Club of America, gave the club at its headquarters, on Jan. 6, an admirable talk on his automobile trip last summer all around Europe, when accompanied by Mrs. Wheeler he made a tour from Paris to Salsburg in the Tyrol and thence back through Germany to Holland and Belgium. The lecture was full of humor and good points, and was enthusiastically received by a large audience of club members and friends. It was also profusely illustrated by at least 150 lantern slides from photographs of novel and pretty bits of road, scenery, etc., secured by the doctor himself during this delightful outing.

Trade Notes.

D. M. STEWARD MFG. Co., of Chattanooga, Tenn., which makes lava insulators, etc., has moved its New York offices from 107 Chambers Street to 8 Jay Street.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, 183 Lake Street, Chicago, general Western agent of the Eureka flexible conduit, reports a very flattering reception of this conduit in the West. Eureka has been in the West only three months, and the Metropolitan Company has had large and rapidly increasing business in it.

FRANK H. STEWART & CO., of Philadelphia, report not only a good trade in general electrical supplies, but an excellent demand for the well-known Stewart patent adjustable handle for flexible cords. It relieves all strain of the socket connections and rosette and allows handy adjustment at any desired vertical drop. It will grip any size cord.

THE MECHANICAL BOILER CLEANER COMPANY, 413 Western Union Building, Chicago, is in receipt of a very flattering letter of recommendation from the Commonwealth Hygienic Ice Company, in which it states that after putting on cleaners in five of its boilers, it ran the boilers for twelve weeks without opening, and then found them absolutely clean and free from scale. It also speaks highly of the cleaner as a purifier, and recommend it especially for ice companies and brewers.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, of Warren, Ohio, has recently placed on the market a full line of miniature battery lamps, series lamps, multiple lamps and candelabra lamps ranging in candle power from ½ candle-power to 8 candle-power, and in voltage from 2½ volts to 125 volts. The company also in addition to its regular line of standard incandescent lamps, makes as specialties telephone and elevator signal lamps, dental lamps, surgical lamps of all descriptions, and a new type of lens lamp.

GRAPHITE FACINGS.—Graphite is used in foundries as a facing for the surface of a mold for the purpose of preventing adhesion of the metal to the sand of which the mold is composed. The result is a much cleaner and smoother casting. The Joseph Dixon Crucible Company, Jersey City, N. J., in a little pamphlet recently issued, gives some interesting information about the use of graphite for this purpose. The various grades of graphite for facings are referred to and the characteristics of each pointed out.

A CALENDAR DESK PAD with space for daily memoranda has been put out by the Emerson Electric Mfg. Co., 714-718 St. Charles St., St. Louis, Mo., as a 1903 souvenir and reminder. As is well known the Emerson Company is a large manufacturer of alternating current power motors, desk and ceiling fans. Interspersed throughout the calendar are suggestions as to the usefulness of handling Emerson products, and little homilies for the salesman referring to various types of motors for different classes of work among possible customers.

BRAIDED CORDS.—The Samson Cordage Works, 115 Congress Street, Boston, Mass., shows, in a booklet, its full line of braided cords for a great variety of purposes. Its Samson spot trolley cord is well known to the electric railway trade. It has a waterproof finish, as has also the arc light cord, which is another of the Samson Company's products. The company states that experience and tests in running over pulleys show that solid braided cords are much more durable than twisted, cable laid. or hollow braided cords or metal chains or tapes.

CHANGE OF NAME.—The name of the Standard Traction Brake Company of 26 Cortlandt Street, New York City, has, as already intimated, been changed to the Westinghouse Traction Brake Company. This company sells all power brakes for street railway service manufactured by the Westinghouse Air Brake Company, including straight or automatic air-operated brakes with axle-driven or motor-driven compressors, the storage system of air-brakes, and the Westinghouse combined magnetic brake and electric car-heating apparatus.

AS TO CATCH-PHRASES.—A catch-phrase in trade is unquestionably a good feature when maintained until it becomes thoroughly identified with a concern, but the connection of the trade to the name does not always become familiar to everyone. Nearly every one in the electrical trade knows that "Homer of Cleveland" applies to the Homer Commutator Company of Cleveland, but unfortunately the U. S. Postal authorities are not so well up in the idioms of the trade; hence the Cleveland concern requests that patrons who desire to receive prompt attention to their wants address their communications to the "Homer Commutator Company, Mason Street, Cleveland, Ohio."

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 30, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

716,476. SUPPRESSING SPARKING OF COMMUTATORS; R. H. Read, Schenectady, N. Y. App. filed April 8, 1901. Means for suppressing the arc comprising a tubular passage communicating with one point of contact and means for forcing the arc products through said passage. (Issued Dec. 23.)

716,649. CIRCUIT BREAKER; E. A. Stevens, Chicago, Ill. App. filed July 19, 1901. (See page 82.)

716,654. CABLE-HANGER; P. H. Auxer, Cleveland, Ohio. App. filed May 28, 1902. (See page 82.)

716,855. GAS IGNITER; H. Bergner, Frankfort-on-the-Main, Germany. App. filed Aug. 16, 1902. Main and pilot valves are electro-magnetically controlled in relation to the heating of a platinum igniter.

716,868. GROUND DETECTOR FOR ELECTRIC CIRCUITS; F. Conrad, Wilkinsburg, Pa. App. filed July 12, 1901. A movable vane connected to the ground, a number of stationary vanes in inductive relation thereto and condensers the elements of which are respectively short portions of the circuit wires and corresponding lengths of metal supported thereby, the latter being connected to the stationary vane.

716,871. LOCOMOTIVE CAB ELECTRIC RAILWAY SIGNAL; E. B. Cutten, New York, N. Y. App. filed June 22, 1891. A peculiar form of contact wheel arranged to run upon a third rail.

716,889. ELECTRIC LAMP; M. W. Hanks, Pittsburg, Pa. App. filed May 18, 1901. The heater and glower are connected in parallel on a series circuit.

716,953. ELECTRIC ELEVATOR; F. J. Sprague, New York, N. Y. App. filed Oct. 29, 1894. Improvements consist mainly in substituting an improved pilot motor and circuits for controlling the connections and operation of the main motor, whereby the number of wires carried to the car are reduced to four; also other improvements.

716,955. METHOD OF SIMULTANEOUSLY TRANSMITTING AND RECEIVING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. Consists in transmitting signal waves, causing them to effect a zero difference of potential at the terminals of the receiver and causing the received waves to combine to effect a certain difference of potential at said terminals.

716,971. ELECTRICAL MEASURING INSTRUMENT; E. Weston, Newark, N. J. App. filed May 7, 1902. Interlocking parts are provided whereby the instrument is prevented from moving when in the casing.

716,974. ELECTRIC LAMP; A. J. Wurts, Pittsburg, Pa. App. filed May 5, 1902. An improvement in Nernst lamps whereby assembling and renewal of parts is facilitated.

716,978. SECTION INSULATOR; J. M. Anderson, Boston, Mass. App. filed Aug. 25, 1902. The device consists of two terminal pieces to be secured to the ends of the wire and an intermediate joining piece.

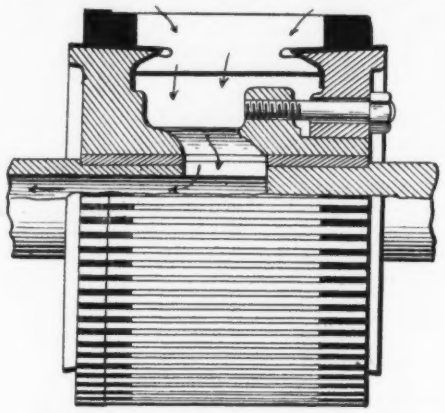
716,988. OVERHEAD ELECTRIC TROLLEY WIRE; J. P. Cribb, Southsea, Eng. App. filed Sept. 8, 1902. A tilting connection which maintains the circuit complete, so long as the wire is horizontal, but in case the latter breaks and falls, the connector opens the circuit to render the broken end dead.

716,995. ELECTRIC RAILWAY; E. W. Farnham, Chicago, Ill. App. filed April 11, 1902. By a movement of a portion of the third rail an oscillatory switch device is thrown to close the circuit to a section of the rail.

716,996. ELECTRIC CLOCK; M. Fischer, Zurich, Switzerland. App. filed Sept. 3, 1901. Details.

717,006. TRANSFORMER; S. E. Johannesen, Edgewood Park, Pa. App. filed Oct. 30, 1902. Passages are provided for the circulation of air between the coils and parts of the core.

717,009. METHOD OF MAKING ELECTRIC CONDUITS; A. M. Lougee, Boston, Mass. App. filed May 31, 1902. Layers of different material possessing different degrees of hardness are vulcanized upon the tube.



716,476.—Suppressing Sparking of Commutators.

717,015. AUTOMATIC ELECTROMAGNETIC FLASHER; P. E. Oswald, Chicago, Ill. App. filed Feb. 5, 1902. Details.

717,022. GLOWER FOR ELECTRIC LAMPS; H N. Potter, Berlin, and W. Nernst, Göttingen, Germany. App. filed September 29, 1899. (See Current News and Notes.)

717,035. THERAPEUTIC ELECTRICAL APPARATUS; I. E. Shaffer, Mount Vernon, N. Y. App. filed March 17, 1902. Electrodes are placed in the path of a moving stream while it is being directed upon the part to be treated.

717,046. SOUNDING MECHANISM FOR TELEGRAPH OFFICES; J. C. Stewart, United States Army. App. filed March 18, 1902. Air pressure is released by the operation of valves to strike a heavy blow and thereby create a loud sound.

717,051. CONTROLLER FOR ELECTRIC MOTORS; H. R. Stuart, Wilkinsburg, Pa. App. filed April 2, 1902. Two groups of contacts are spirally arranged on opposite sides of the drum, which is moved by a single handle both to change the direction of rotation of the motor and to vary the speed.

717,065. DISTRIBUTING ELECTRIC CURRENTS; Engelbert Arnold, Ole Sivert Bragstad and Jens Lassen La Cour, of Karlsruhe, Germany. App. filed Dec. 31, 1900. Relates to a type of transformer for use with the Arnold system of simultaneous transmission over the same line of alternating currents of different phases or periodicities. The transformer for a single phase and a n-phase circuit has (n + 1) cores. The primary winding is connected in star and the secondary windings for receiving the superposed currents are connected in series.

717,070. CONTACT BOX FOR ELECTRIC RAILWAYS; W. Milt, Johnstown, Pa. App. filed Nov. 30, 1901. Details.

717,071. ELECTRIC SWITCH; M. Milt, Johnstown, Pa. App. filed April 18, 1902. The switch has two open circuit positions and an intermediate closing position, a locking device for holding the switch in one of its open positions and means for retarding or prolonging the movement across its closing position.

717,072. MAGNETOTHERAPEUTIC APPARATUS; J. Burry, Brooklyn, N. Y. App. filed May 8, 1901. A number of solenoids surrounding a common space in which the part to be treated is placed and a switch for throwing the solenoids into circuit.

717,075. RAILROAD SIGNAL AND ALARM; A. E. Caughey, Omaha, Neb. App. filed Dec. 12, 1901. Details.

717,107. SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed May 19, 1900. One of the elements carries a paste containing flourin.

717,108. SECONDARY BATTERY; W. Morrison, Chicago, Ill. App. filed Aug. 5, 1901. See preceding patent.

717,112. ELECTRICAL SIGNALING SYSTEM; A. C. McKnight, Brooklyn, N. Y. App. filed March 7, 1902. Details.

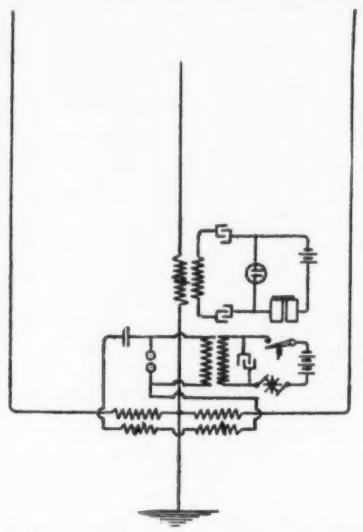
717,123. ELECTRICITY METER; P. Rouget, Paris, France. App. filed Jan. 30, 1902. A series of magnets arranged in separated groups parallel to the flux, whereby none of them can be influenced by the field created by an intense current.

717,137. ELECTRIC SIGNAL GONG; H. C. Thomson, Boston, Mass. App. filed July 29, 1902. The armature carries two hammers adapted to strike two different gongs.

717,152. METHOD OF GENERATING INDEPENDENT ELECTRIC CURRENTS; Engelbert Arnold, Ole Sivert Bragstad and Jens Lassen La Cour, Karlsruhe, Germany. App. filed Jan. 13, 1902. Single phase and polyphase currents are generated in the same armature, the frequency of the former being a multiple of the latter. Details of construction of the generator.

717,188. KEEPER FOR FIRE ALARM BOX KEYS; C. E. Gibson, Indianapolis, Ind. App. filed June 9, 1902. The key to the box is placed in a small fragile case on the outside of the main box.

717,194. ARC LIGHT SWITCHBOARD; E. M. Hewlett, Schenectady, N. Y.; App. filed May 16, 1901. The board is provided with two sets of insulated conductors crossing one another at an angel, one set connecting with the machines and circuits at their ends, and means for cross-connecting the two sets of bars at the points of intersection.



717,513.—Method of Relaying Space Telegraph Signals.

717,201. CUT OUT; J. W. Howell, Newark, N. J. App. filed Feb. 2, 1901. A form of paper contact in which the terminals are flat plates instead of points, as usual.

717,203. INDUCTION COIL OR LIKE INSTRUMENT; O. H. Buebel, Brooklyn, N. Y. App. filed Jan. 21, 1902. Details of the circuit controller mounting.

717,212. PROTECTIVE APPARATUS; W. Kaisling, Chicago, Ill. App. filed Aug. 8, 1901. (See page 82.)

717,218. TELEPHONE-TRANSMITTER; T. C. Knowles, Denver, Colo. App. filed April 1, 1902. (See page 82.)

717,219. TRAIN CONTROL SYSTEM; S. L. G. Knox, Milwaukee, Wis.; App. filed June 5, 1902. Improvements in a master and sub-controller system.

717,227. ELECTRICAL SWITCH; H. Lomax, R. Lomax and J. Tomlinson, Darwen, Eng. App. filed Oct. 18, 1901. Details.

717,233. HOLDER FOR ELECTRIC LAMP CARBONS; P. F. Maines, Philadelphia, Pa. App. filed March 14, 1902. An eccentric clamp for the carbon is arranged in a hole through which the carbon passes.

717,234. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Samuel W. Manger, Schenectady, N. Y. App. filed June 8, 1900. An arrangement of synchronizing circuit which simplifies the wiring and involves the use of but one indicator for any number of machines.

717,262. MULTIRATE METERING; E. Oxley, Lynn, Mass. App. filed July 27, 1899. An independent control wire is run from the station, between which and the supply wires of the system, the meter operating circuits are connected.

717,277. COMPOUNDING ALTERNATORS; E. W. Rice, Schnectady, N. Y. App. filed June 8, 1900. (See Current News and Notes.)

717,285. LIGHTNING ARRESTER; H. R. Sargent, Schenectady, N. Y. App. filed March 27, 1901. Resistance is inserted in series with the air gap as soon as a lightning discharge has passed, so that the line current which tends to follow the discharge is blocked sufficiently to break the arc.

717,291. TROLLEY CONNECTION AND GUARD FOR ELECTRIC CARS; J. G. Sharwell, Newark, N. J. App. filed April 10, 1902. Details.

717,298. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schnectady, N. Y. App. filed Aug. 19, 1899. (See Current News and Notes.)

717,300. CURRENT-PROTECTIVE DEVICE; W. A. Taylor, Chicago, Ill. App. filed Aug. 3, 1901. (See page 82.)

717,303. SPEED LIMITING DEVICE FOR SERIES MOTORS; L. A. Tirrill, Lynn, Mass. App. filed June 5, 1902. A magnet coil in circuit with the motor releases the rheostat arm when the speed passes a critical point.

717,310. RHEOSTAT OR ELECTRIC HEATER; G. P. Wisdom, New York, N. Y. App. filed Aug. 6, 1901. A resistance consisting of a pile of buckled plates adapted to be forced into more or less uniform contact.

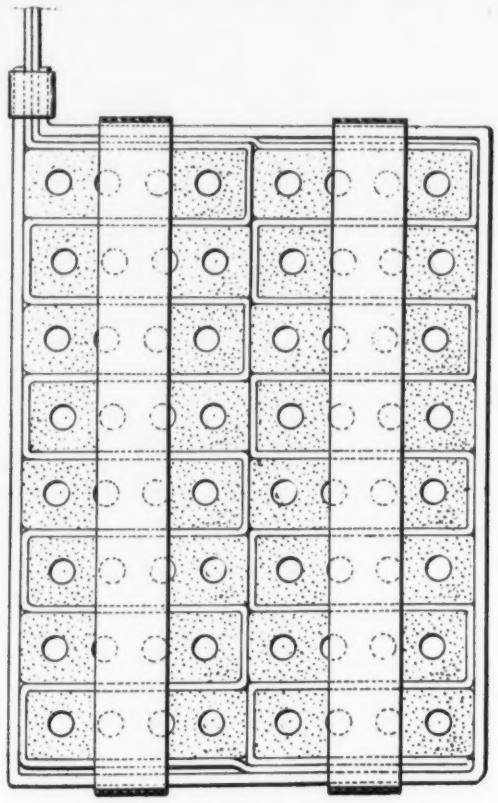
717,322. INSULATOR FOR HIGH POTENTIAL LINES; C. E. Barry, Schenectady, N. Y. App. filed July 30, 1901. An arrangement of cross-heads embedded in insulating material contained in cups.

717,324. SUPPORT FOR HIGH TENSION TROLLEY; A. F. Batchelder, Schenectady, N. Y. App. filed July 24, 1901. The high tension wires are supported by cross wires extending between two insulators.

717,325. APPARATUS FOR AUTOMATICALLY BLOCK SIGNALING ON RAILWAYS; F. B. Behr, Twickenham, Eng. App. filed March 5, 1901. Details.

717,327. AUTOMATIC ELECTRIC EXCHANGE SYSTEM; W. R. Binkley, New Bedford, Mass. App. filed July 14, 1902. (See page 83.)

717,331. SYNCHRONIZING APPARATUS FOR ALTERNATORS; Thomas



717,416.—Secondary Battery.

D. Boyles, Schenectady, N. Y. App. filed July 27, 1900. A switching circuit and switch plugs whereby a single voltmeter may be used in synchronizing without great complexity of wiring.

717,351. STORAGE BATTERY; C. H. Clare, Quincy, Mass. App. filed March 1 1902. Means for preventing the detachment of active material.

717,358. FREQUENCY-COMPENSATING MEANS FOR ELECTRIC METERS; A. G. Davis, Schenectady, N. Y. App. filed May 21, 1900. (See Current News and Notes.)

717,359. ROTARY TRANSFORMING APPARATUS; A. G. Davis, Schenectady, N. Y. App. filed May 26, 1900. (See Current News and Notes.)

717,376. ELECTRIC RECORDING INSTRUMENT; W. C. Fish and F. P. Cox, Lynn, Mass. App. filed June 12, 1901. A movable member free to assume without restraint any position within its range and adapted to control a curve drawing pencil.

717,389. THIRD RAIL INSULATOR; E. Gonzenbach, Wheaton, Ill. App. filed Sept. 24, 1902. A standard capped by an insulating ring held in place by a metal ring upon which the rail rests.

717,394. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. The elements of the battery are continuously brushed to free them from precipitates.

717,395. ELECTRIC BATTERY; H. Halsey, New York, N. Y. App. filed April 18, 1902. See the preceding patent.

717,398. TROLLEY WIRE SUPPORT; E. Hill, Jr., Norwalk, Conn. App. filed April 18, 1902. Two plates clamped together upon the wire and containing cavities for solder.

717,401. TROLLEY STAND; H. Holland, Detroit, Mich. App. filed March 7, 1902. Details.

717,406. RAILWAY ELECTRIC SIGNAL; S. W. Huff, Baltimore, Md. App. filed Dec. 6, 1898. Each signal is provided with an automatic device for setting it to the position which it is normally to assume and with an electrical tripping mechanism set in operation by the train at a given point, provided certain conditions exist on the track to be guarded.

717,414. TROLLEY STAND; W. H. Kilbourn, Greenfield, Mass. App. filed April 1, 1902. A dash pot prevents the rapid upward movement of the arm.

717,416. SECONDARY BATTERY; I. Kitsee, Philadelphia, Pa. App. filed April 10, 1893. A particular construction for the conductor whereby expanding room for the active material is provided.

717,423. TROLLEY STAND; O. F. Lidke, Detroit, Mich. App. filed Dec. 14, 1901. Details.

717,428 and 717,429. TELEPHONE-RECEIVER; K. B. Miller, Chicago, Ill. App. filed June 22, 1900. (See page 82.)

717,442. ELECTRIC RADIATOR; J. F. McElroy, Albany, N. Y. App. filed Jan. 16, 1896. A construction of casing for the heater adapting it to be placed against the riser of a seat.

717,443. COMBINED MAGNETIC AND MECHANICAL BRAKE; J. F. McElroy, Albany, N. Y. App. filed July 14, 1899. By turning the brake handle a magnetic brake is first applied and afterwards the mechanical brake, if necessary.

717,451. CURRENT DIRECTOR; J. Reid, Jr., Watervliet, N. Y. App. filed Sept. 15, 1899. Details of a snap switch.

717,464. SYSTEM OF ELECTRICAL DISTRIBUTION; C. P. Steinmetz, Schenectady, N. Y. App. filed Aug. 19, 1899. (See Current News and Notes.)

717,467. METHOD OF ELECTRICAL DISTRIBUTION; J. S. Stone, Cambridge, Mass. App. filed Aug. 4, 1902. Consists in causing signals which are to be transmitted to effect the transmission of similar signal by currents of different frequency which shall act upon a properly attuned receiver by which the signals shall be received.

717,468. ELECTRIC CURRENT CONTROLLER FOR INCANDESCENT LAMPS OR MOTORS; H. A. Strauss, New York, N. Y. App. filed Nov. 12, 1902. The lamp socket consists of a cylinder of resistance material into which the lamp is thrust any required distance to vary the current.

717,477. END CELL SWITCH INDICATOR; A. C. Walther, East Orange, N. J. App. filed Feb. 17, 1902. Details.

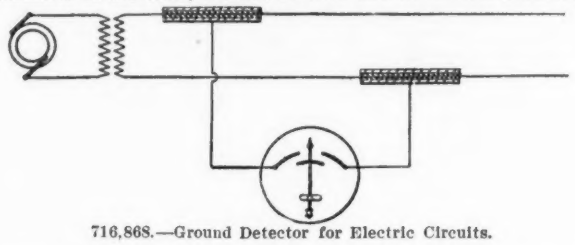
717,488. METHOD OF TRANSFORMING ALTERNATING CURRENTS; J. E. Woodbridge, Schenectady, N. Y. App. filed July 28, 1900. A modification of the Scott two-phase, three-phase system of phase transformation, whereby the current in all of the windings is maintained in phase with the e.m.f of the windings.

717,496. METHOD OF MEASURING THE ENERGY OF THREE-PHASE ALTERNATING CURRENT CIRCUITS; F. Conrad, Wilkinsburg, Pa. App. filed Feb. 14, 1901. Consists in separately measuring the product of the current and voltages of two of the circuits and at the same time measuring the product of the current of the third circuit by the voltages of the said two circuits.

717,497. ELECTRIC ARC LAMP; H. Cuenod, Geneva, Switzerland. App. filed July 10, 1902. Details.

717,507. EXCITING-ALTERNATOR; E. W. Rice, Schenectady, N. Y. App. filed June 8, 1900. (See Current News and Notes.)

717,509. APPARATUS FOR RELAYING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. A relay adapted to be set in motion by the receiver of one system and thereby to operate the transmitter of the other, the said receiver and transmitter conductor being



716,868.—Ground Detector for Electric Circuits.

so electrically organized respectively that the receiver will not be operated by signals sent by the transmitter.

717,510. METHOD OF RELAYING SPACE TELEGRAPH SIGNALS: J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. See No. 717,509.

717,511. METHOD OF TUNING VERTICAL WIRE OSCILLATORS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. The tuning is accomplished by distributing the electro-magnetic inertia along the wire and balancing it by a suitable capacity.

717,512. TUNED ELECTRIC OSCILLATOR; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. Apparatus for carrying out preceding method.

717,513. METHOD OF RELAYING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. See No. 717,509.

717,514. APPARATUS FOR RELAYING SPACE TELEGRAPH SIGNALS; J. S. Stone, Boston, Mass. App. filed Jan. 23, 1901. See No. 717,509.

717,515. METHOD OF ELECTRICAL DISTRIBUTION; J. S. Stone, Cambridge, Mass. App. filed Aug. 4, 1902. Method of absorbing the energy of current of one frequency traversing a main line to the exclusion of that of currents of other frequencies on the line, consisting in diverting the energy of the current of the desired frequency by means of a condenser into a local resonance circuit and containing a tuning condenser of small capacity compared to that of the other condenser.

717,518. METHOD OF TRANSFORMING ALTERNATING CURRENTS; J. E. Woodbridge, Schenectady, N. Y. App. filed July 28, 1900. Identical with patent No. 717,488, except in phraseology of claims.

716,867. MEANS FOR MEASURING THE ENERGY OF THREE-PHASE ALTERNATING CURRENTS; F. Conrad, Wilkinsburg, Pa. App. filed Dec. 30, 1902. Two wattmeters are used, the armatures of which may be mounted on the same shaft. The shunt windings are connected to the secondaries of transformers across the line and receive voltages proportional to that of two of the three-phase circuits. The series windings are so connected as to receive currents proportional to the two above circuits, and also to receive jointly current proportional to that of the third circuit.